July 1944

TECHNOLOGY REVIEW

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The name SANDEE has become synonymous with all that is newest and best in Extruded Plastics! For here, highly skilled plastics engineers, working with modern methods and machinery, produce Tubing, Strips, Rods, Tees, and Custom Plastic Sections to the most exacting specifications. SANDEE rigid and flexible plastic extrusions are of *uniform* fine quality. Only the best of tested materials and workmanship are employed. If your war-vital product or postwar plans call for plastic extrusions, be sure to ask for the friendly counsel and cooperation of our long experienced engineers. Deliveries are surprisingly prompt considering wartime scarcities.

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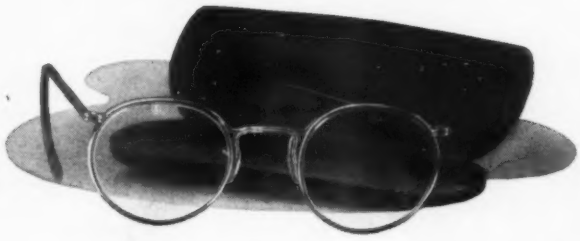


This is a pair of AO Goggles. Their cost: around $1.50. On one of your skilled workers, they may save you $1,000 or more . . . for the eye accidents they help to prevent . . . *and the trained skill they help to protect.*

AO GOGGLES protect eyes & man-hours & profits

They're more than an investment in eye protection. For the price you spend for AO Goggles, you give a worker freedom from fear of injury. You let him concentrate on his job. You help him put in more man-hours. *And you keep production up and costs down.*

American Optical
COMPANY
SOUTHBRIDGE, MASSACHUSETTS

...CALL IN AN AO MAN—AND KEEP YOUR "PRODUCTION-EYES" PRODUCING

THE TECHNOLOGY REVIEW, July, 1944. Vol. XLVI, No. 9. Published monthly from November to July inclusive at 10 Ferry Street, Concord, N. H. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription $3.50; Canadian and Foreign subscription $4.00. Entered as second-class matter at the Post Office at Concord, N. H., under the Act of March 3, 1879.

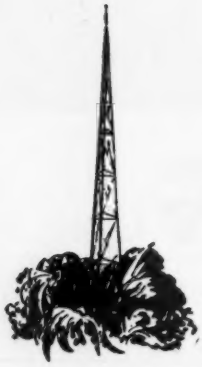
THIS IS THE VOICE OF FRANCE

Instead of the silvery Seine — the murky Congo. Instead of well-tended fields and spotless villages — African jungle. Instead of a nation of Frenchmen — a handful of over-worked technicians and hundreds of African natives.

Yet here, three hundred miles up the Congo, is the true voice of France. Here at Brazzaville a gallant group of Free French brought in American equipment and erected one of the most powerful short-wave transmitters in the world. Every hour of the day, the voice of Free France thunders from Brazzaville, speaking in twenty different languages—spreading truth among the conquered peoples of the world—sending bulletins to the Free French fleet.

This tiny outpost is one of the most important voices of France —and Freedom—in the world.

H.R.O. receivers are standard equipment used exclusively in this station for monitoring and rebroadcasting. Brazzaville is the Voice of France, and these receivers are the Ears of Brazzaville.



NATIONAL COMPANY

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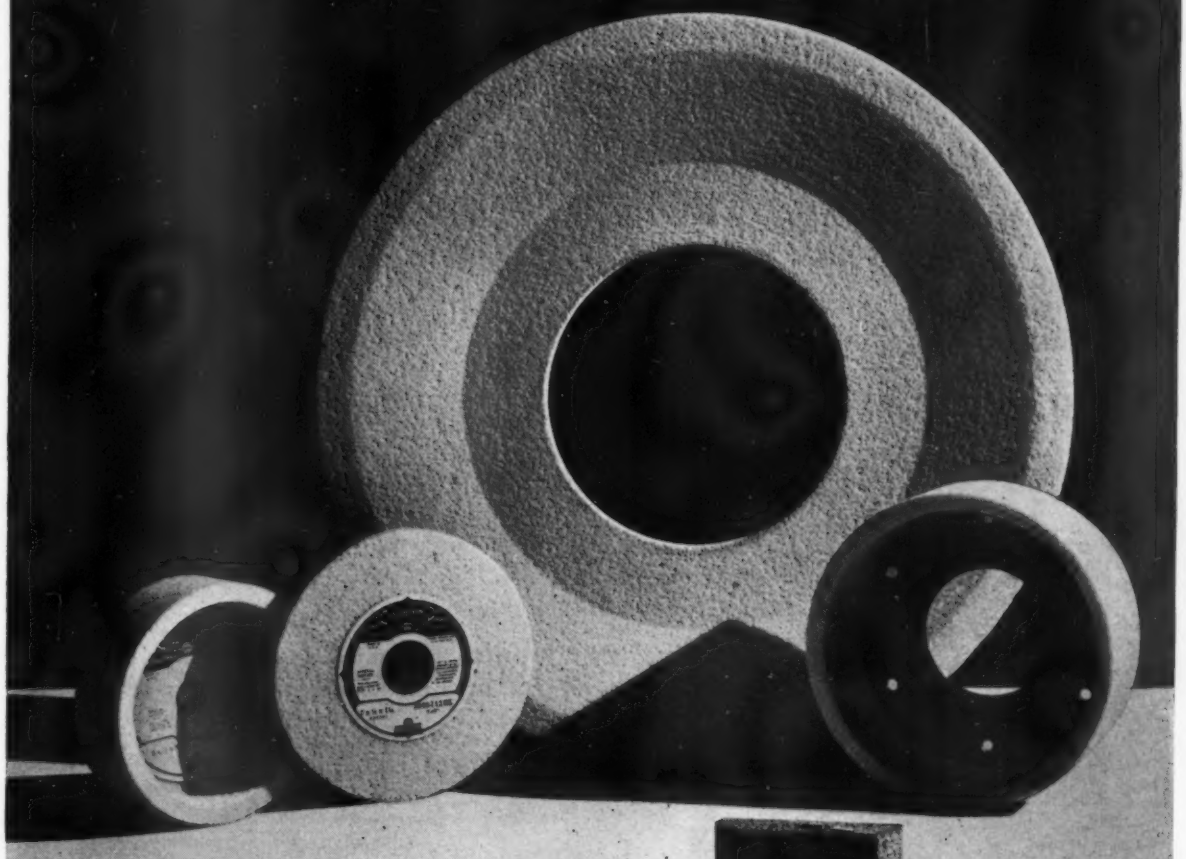
NATIONAL RECEIVERS ARE IN SERVICE THROUGHOUT THE WORLD

NORTON OPEN STRUCTURE GRINDING WHEELS

. . . Up to 24" Diameter Now



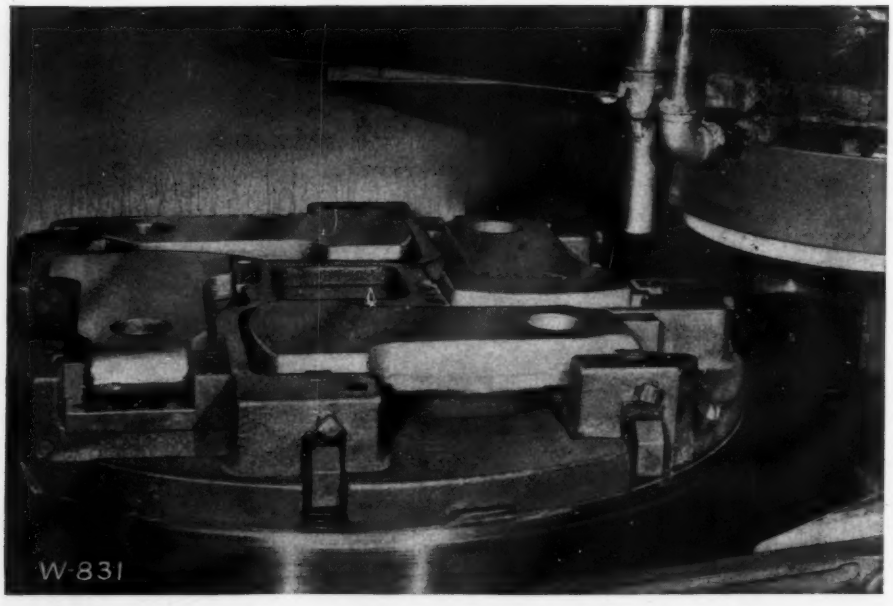
Industry now need not be handicapped by size limitations on grinding jobs that require open structure wheels—where the contact is broad—where the stock removal is especially heavy —where extra coolness of cut is essential.

Norton Open Structure Wheels are being supplied as large as 24" diameter by 4" wide and 20" diameter by 6" wide—and, of course, in all the usual tool room and surface grinding sizes and shapes, including segments.

Norton Open Structure Grinding Wheels and segments are *uniform*—the same grinding action every time—a result of the Norton Controlled Structure process of manufacture.

NORTON COMPANY, Worcester 6, Mass.
Behr-Manning, Troy, N. Y., is a Norton Division

NORTON ABRASIVES



The advantages of BLANCHARD *grinding*

★*Production*

Adaptability

Fixture Saving

Operation Saving

Material Saving

Fine Finish

★*Flatness*

Close Limits

★*Production* ★*Flatness*

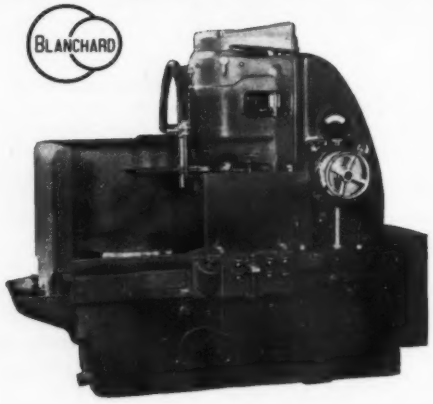
Crankshaft Cheeks ground from the rough

These crankshaft cheeks of tough alloy steel are ground from the rough forging removing .080" stock from the surface at the rate of 12 pieces per hour.

This job is typical of many production jobs in which the Blanchard grinds the first surface on the rough casting or forging, making a dependably flat surface from which all later operations can be located.

"Put it on the Blanchard"

Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.



This job being done on the No. 18 Blanchard Surface Grinder

The
BLANCHARD MACHINE COMPANY

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We can all be Proud of that Improvement

"It was just about 15 years ago, Jim, that the first plans came off the Busch-Sulzer designing boards for trunk pistons in big Diesels. Even you fellows here in the shop were skeptical, remember?"

"We sure were Boss—and so was the industry when we built the biggest trunk-piston Diesel on Earth."

"But these big fellows have proved themselves year in and year out, Jim. We can honestly say that we have built Diesels that built Busch-Sulzer's reputation."

Busch-Sulzer Diesels are simple, dependable and long-lasting. In improving its product constantly for over 45 years, America's oldest builder of Diesel engines has striven always for simplicity of design. As a result, a Busch-Sulzer Diesel offers maximum continuity of operation with a corresponding minimum of time lost on inspection and maintenance.

Busch-Sulzer offers single-acting two-cycle engines up to 8000 BHP in one unit. Busch-Sulzer also has a complete line of four-cycle engines in sizes 225 BHP to 1500 BHP, in super-charged and unsuper-charged types, suitable for marine or stationary use. A request on your letterhead will bring particulars.

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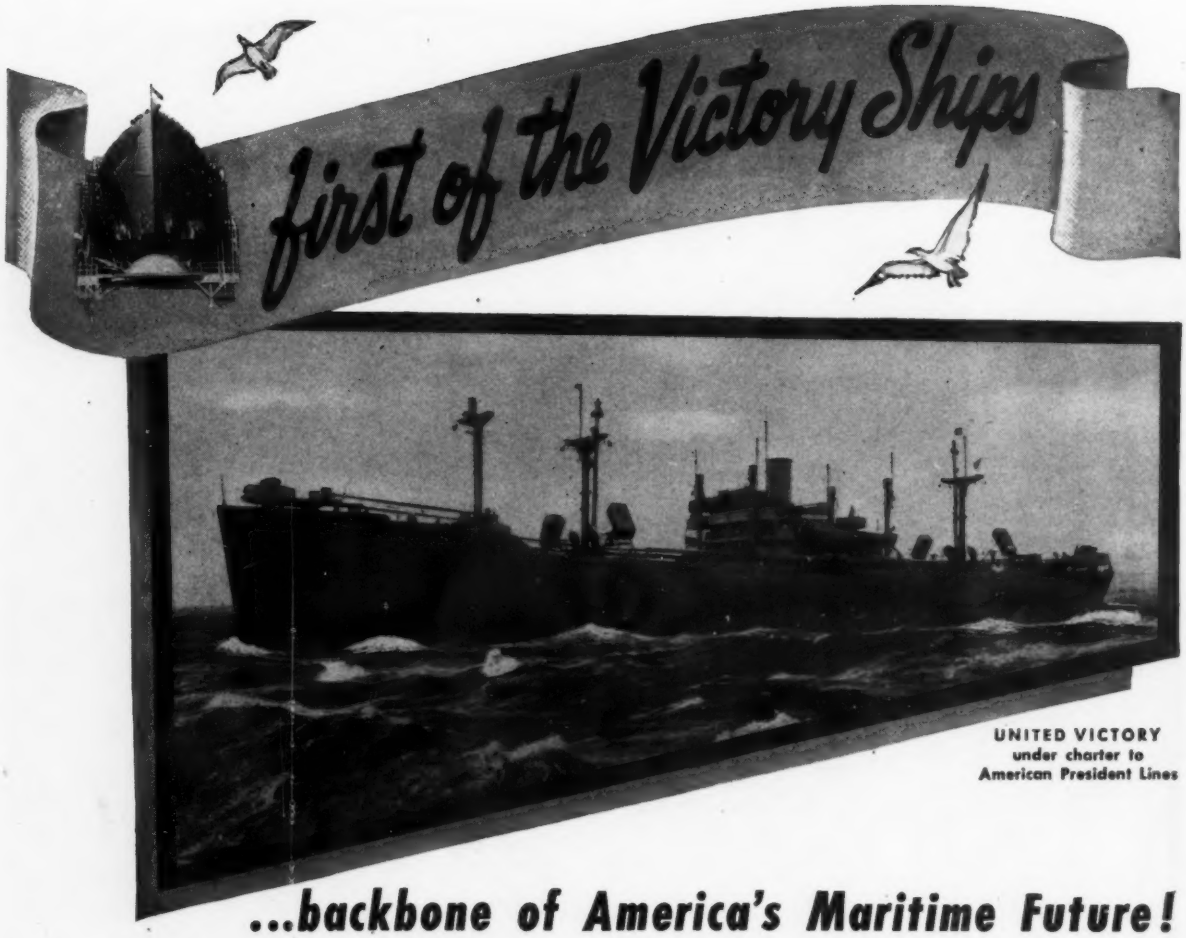
BUSCH-SULZER BROS.–DIESEL ENGINE COMPANY • SAINT LOUIS

AMERICA'S OLDEST BUILDER OF DIESEL ENGINES



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...backbone of America's Maritime Future!

Speedier, more efficient than their predecessors, the famous Liberties, the new VICTORY Ships are coming down the ways.

Incorporated in their design and construction is the knowledge gained from the building of the greatest cargo and Naval fleet the world has ever known.

As a result, they meet the requirements of the Armed Forces for fast ships to deliver troops and supplies to every theater of the war, and are destined to become the backbone of our peacetime Merchant fleet.

The list of their names reads like a roll call of the Allied Nations: United Victory, the first to be completed, was launched after only 55 days on the building ways and was followed by the Czechoslovakia Victory, China Victory and the Poland Victory. The first four ships* were all delivered well ahead of schedule.

Deep in their hulls, and in many of those to follow, are powerful Combustion Engineering Boilers, giving them the speed and reliability so vitally needed to make them truly the ships of Victory.

*United Victory, Czechoslovakia Victory and Poland Victory — built by Oregon Shipbuilding Corporation, Portland, Oregon. China Victory — built by California Shipbuilding Corporation, Wilmington, California. A-788

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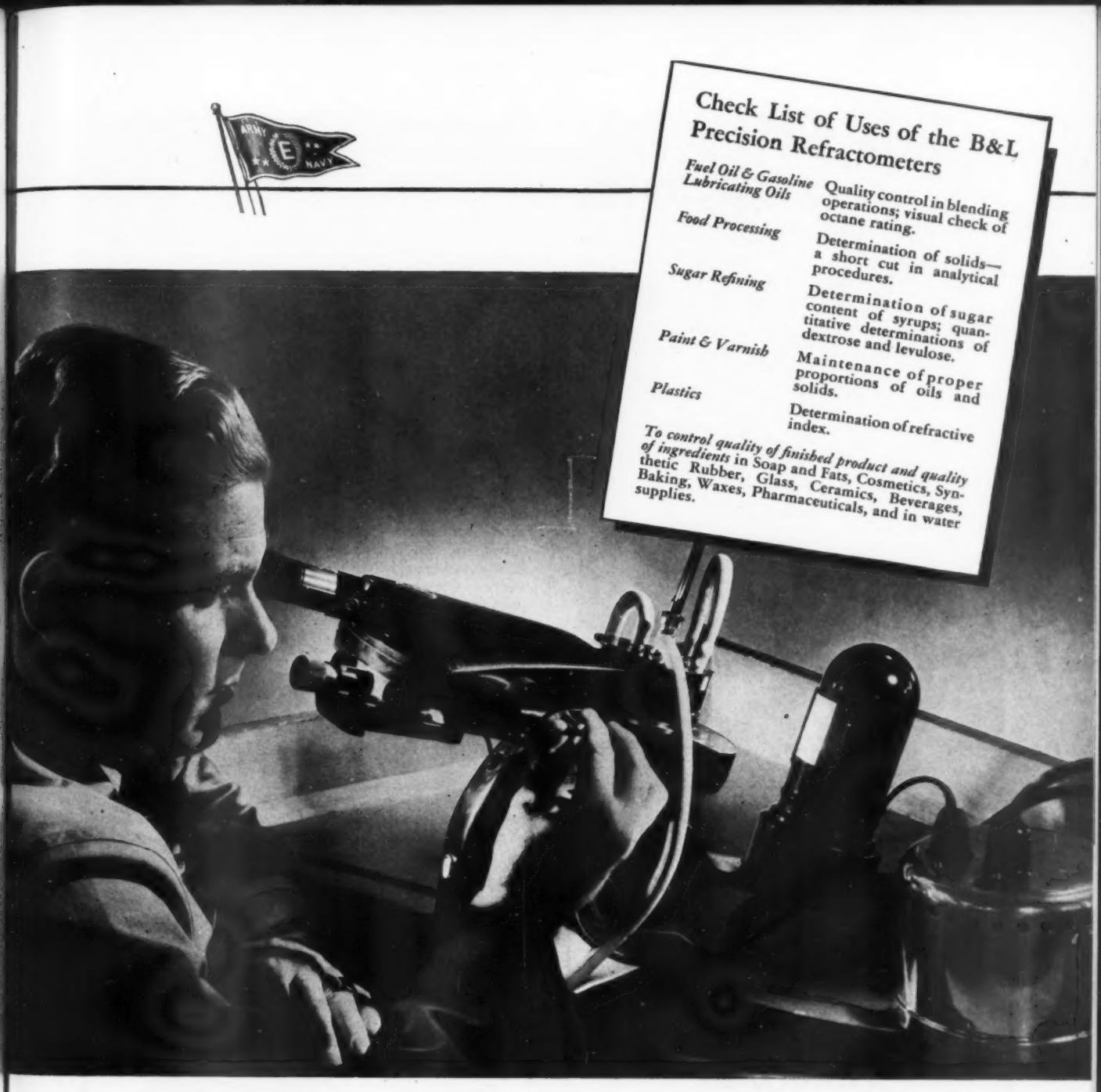
C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS


ARMY
NAVY
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Fuel Oil & Gasoline Lubricating Oils
Quality control in blending operations; visual check of octane rating.
Food Processing
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Sugar Refining
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To control quality of finished product and quality of ingredients in Soap and Fats, Cosmetics, Synthetic Rubber, Glass, Ceramics, Beverages, Baking, Waxes, Pharmaceuticals, and in water supplies.

Where Can You Use a Precision Refractometer?

Will there be a place in your post-war operations where a B&L Precision Refractometer can help you do a better job . . . or, if you are doing essential war work, is there a place where you could use one to advantage now?

The B&L Precision Refractometer is an instrument of permanent accuracy and superior design. Operation is simplified by the small quantity of liquid required, quick temperature regulation and by a minimum of moving parts. The absence of compensator and bearing errors enables readings to 0.00003 for the C, D and F lines, giving both index and dispersion values. Of vital importance, too, is the permanent responsibility of the maker. When and if repairs are needed you can always be sure that Bausch & Lomb will still be in business to furnish the parts or service you need.

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Makers of Optical Glass and a Complete Line of Optical Instruments for Military Use, Education, Research, Industry and Eyesight Correction and Conservation

THE TABULAR VIEW

Unbidden Guests. — Too much of the work which man does goes for the support of ubiquitous and ingenious beasts who have been his fellow travelers for many generations. Discussing these unbidden guests (page 543), CHARLES H. BLAKE, Associate Professor of Zoology at the Institute, explains also some of the steps constituting a proper campaign for control of them. A graduate of Technology in 1925, Professor Blake has been a member of its staff since 1924.

Oil Finders. — Requirements for petroleum, the reserves available to meet them, and methods of prospecting to augment those reserves are recounted from the point of view of firsthand experience in the field (page 546) by ROLAND F. BEERS, President of the Geotechnical Corporation. Dr. Beers, an Alumnus of the Institute as a master of science in 1928, received the doctorate last year. He has made many geophysical surveys for oil companies and is a thoroughgoing student of the subject.

True Teaching. — The rightful aims of education are analyzed (page 549) from a new point of view in an essay drawn from an address delivered by B. EDWIN HUTCHINSON at a meeting of teachers and industrialists in Detroit. A member of the Institute Class of 1909, former President of the Alumni Association, and term member of the Institute Corporation, Mr. Hutchinson is chairman of the finance committee of the Chrysler Corporation.

Southward. — From NEILL JAMES, whose earlier reports of vagabonding have pleased Review readers, comes an account (page 551) of some of the interesting sights which travelers of the future along the Pan American Highway may expect to see. Miss James is at present at work in Mexico.

STAR BRASS MANUFACTURING COMPANY

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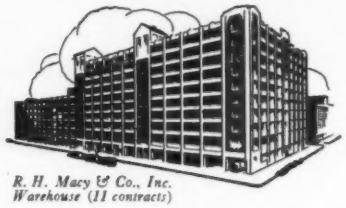
LUCIUS T. HILL '17 RAYMOND STEVENS '17
ALBERT C. SHERMAN, JR. '14

The Review is not published during the summer months following July. This issue, therefore, concludes Volume 46. Number 1 of Volume 47 will be published on October 27 and dated November. Readers who bind their copies are reminded that if they possess nine issues of Volume 46, their files are complete. An index to the volume will be ready on September 30 and will be supplied post free upon request.

Speed with Economy



R. H. Macy & Co., Inc. Warehouse (11 contracts)

Sound construction, speed, economy — have made 100% of our present contracts repeat orders. Something to remember when you need a new building.

W. J. BARNEY CORPORATION
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INDUSTRIAL CONSTRUCTION
Alfred T. Glassett, '20, Vice President

It is generally appreciated that the item of perishable tool costs is an important factor in manufacturing accounting. The possibility of savings offered by using molybdenum high speed steels, instead of tungsten types, is therefore worth consideration.

The savings are due first to the lower cost per pound of molybdenum steels, and second to their lower density. The latter results in more tools from an equivalent poundage.

The net savings effected naturally depend on tool performance. It is an established fact that, in a substantial majority of careful comparative tests made in the past, the performance of properly heat-treated molybdenum steels equaled, where it did not better, that of tungsten steels.

A consultation with your supplier should confirm these statements, but it would be a simple matter to check them in your own plant.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company

500 Fifth Avenue • New York City

MOLY

who dares to talk to them about a THIRD WORLD WAR?

They were at Tarawa.
Many of them now wear empty sleeves, or bandages where their eyes were. And a thousand and twenty-six will rise up never from the sands of Tarawa Island.

They couldn't hear it. In the roar of that tornado, as they fought and fell, so far from the hills of home, they couldn't hear the words: " . . . *history repeats . . . and what will we get out of it but . . . how the hell can we police . . . the next one will be against . . . already sowing the seeds for . . . and twenty years from now, brother . . . the Third World War . . .* "

In elevators, on the street, in plush chairs that let you down easy, in columns and editorials and from the political stump.

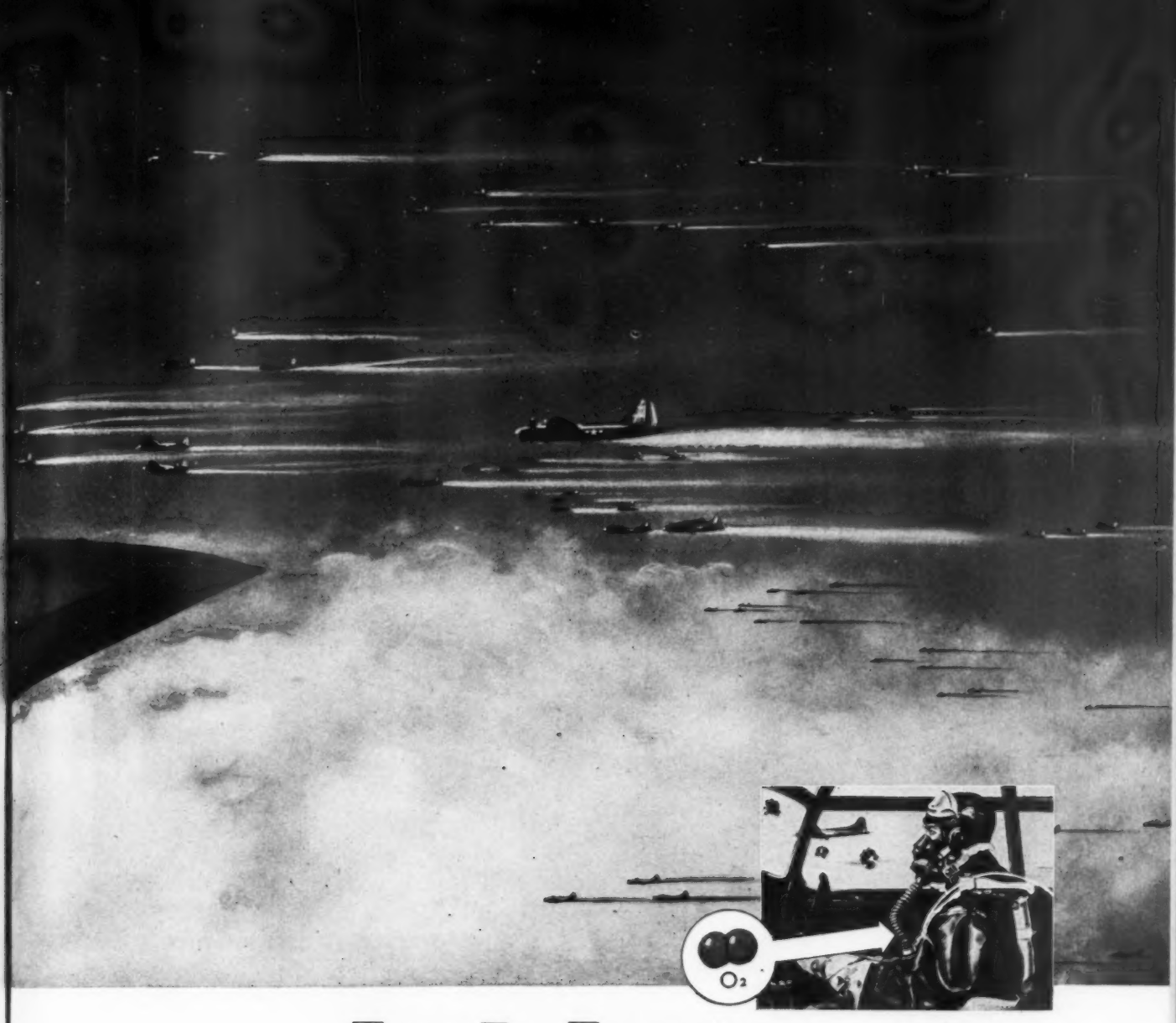
What is the matter with us? Can't we at home at least go into peace with some spark of their courage and determination that this war is not another mockery, not just another World War? Let no man give voice to that weak and deadly cynicism. Let him stand up and think straight and have the courage to call the lie to any man in public or private life who fails to do the same.

And let each of us do everything humanly possible to help win this war sooner . . . buy War Bonds—give blood—boycott the black market . . . and plan ahead now for a *better* America than we had before.

Today, the engineers of the machine tool industry can greatly help the post-war planners of government and business management. One of these is a Bryant man . . . We invite you to send for him.

BRYANT

BRYANT CHUCKING GRINDER COMPANY SPRINGFIELD, VERMONT, U. S. A.



THEY FLY TOGETHER

AT HIGH ALTITUDES—six or seven miles up—oxygen and men must fly together. With oxygen, a plane's crew can live for hours at great heights.

To help guarantee safety, flying oxygen must be especially dry. There must not be even so much as a tiny drop of moisture present to freeze and cut off the life-giving supply of oxygen.

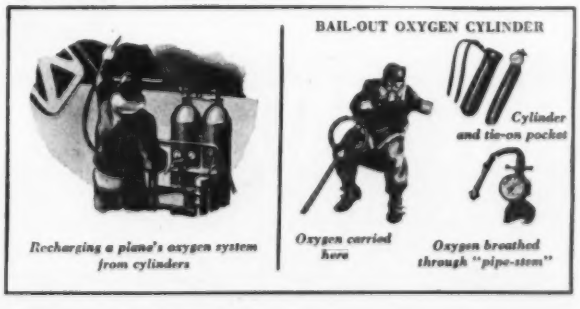
Medical knowledge of oxygen was established long before high-altitude flying became so important. Through scientific research, physicians had found how much oxygen the body needs and what happens when there isn't enough. They found at what altitudes supplementary oxygen becomes necessary and how to administer it.

Co-operating with these scientists, THE LINDE AIR PRODUCTS COMPANY did much to encourage these investigations. Long before the war, this UCC Unit had so mastered the techniques of oxygen production that even its oxygen for industry met the established requirements of purity for human consumption.

Today, this medical and engineering knowledge of oxygen is giving all our fighters a better chance of coming home. Oxygen also is being used for treating pneumonia—and for shock due to wounds, burns, injuries, or following surgery.

▼

Military and civilian physicians are invited to send for "Oxygen Therapy News" P-7, which is published periodically to make available information on significant reports in current medical literature concerning the therapeutic use of oxygen. There is no obligation.


BAIL-OUT OXYGEN CYLINDER
Cylinder and tie-on pocket
Oxygen carried here
Oxygen breathed through "pipe-stem"
Recharging a plane's oxygen system from cylinders

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with TYPE BW INSULATED WIRE WOUND RESISTORS

At the first indication of lessened demand by the Armed Services, IRC will be in an excellent position to immediately supply industry's requirements for resistors of *all* types. That IRC units will be available in ample quantities on a favorable price basis is assured because we have developed and are operating on a mass production basis the world's largest resistor plants.

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Feel free at all times to consult with us on your peacetime product design plans involving resistances. You can be certain of unbiased engineering counsel and secure in the knowledge that the subject matter will be held inviolate.

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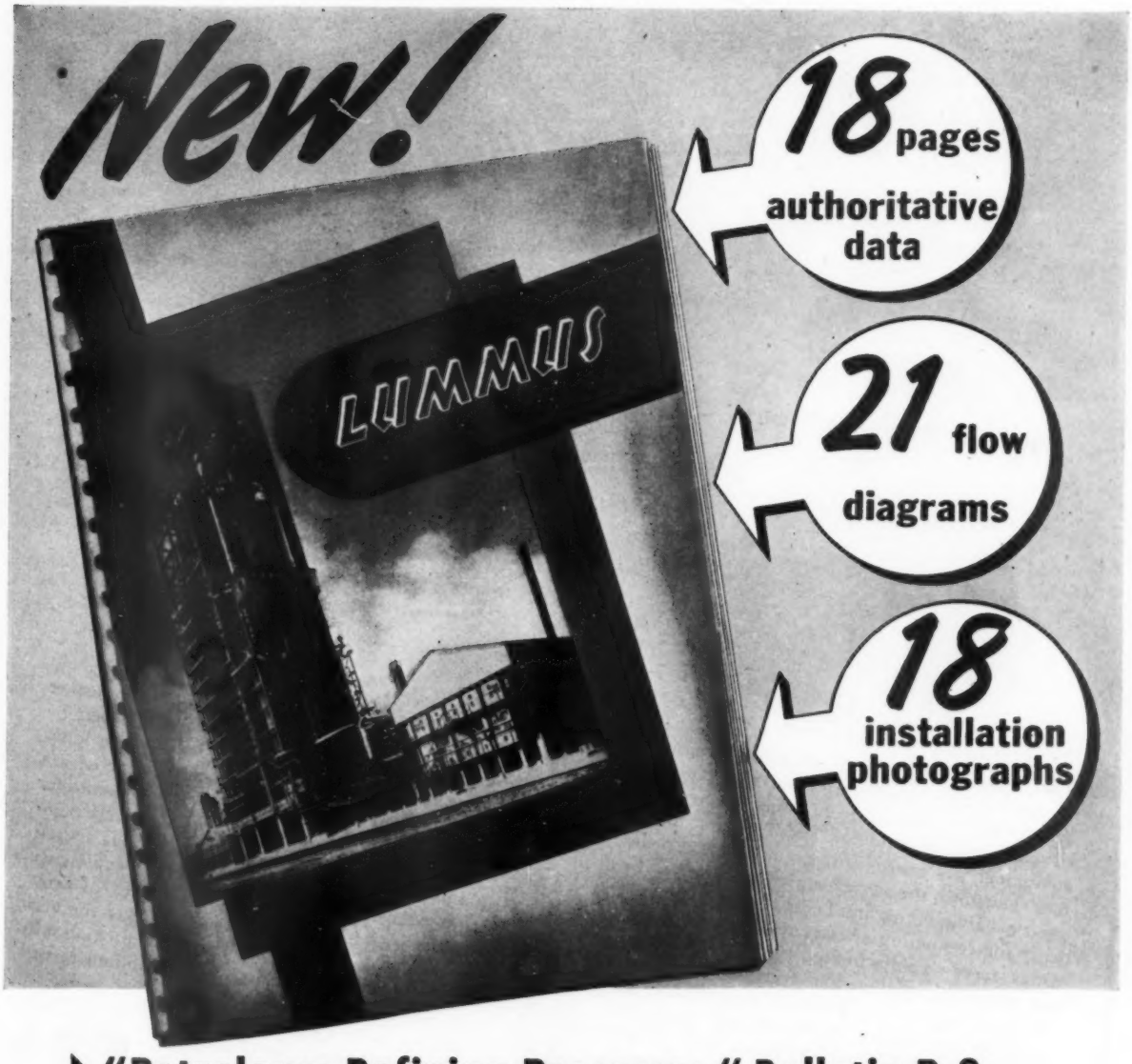
1. *Completely insulated wire wound of standard ½, 1 and 2 watt sizes.*
2. *Resistance values: ½ watt—from .24 ohms to 800 ohms; 1 watt—from .5 ohms to 5000 ohms; 2 watt—from 1.0 ohms to 8000 ohms.*
3. *Have wire wound stability and are physically interchangeable with carbon types.*
4. *Available in matched pairs to 1% or 2% for close-tolerance, high-stability applications.*
5. *Element is space wound with copper-nickel or nichrome bare wire securely crimped and molded integrally with leads.*

PREFERRED FOR PERFORMANCE • IRC • FIXED RESISTORS

INTERNATIONAL RESISTANCE CO.



"Petroleum Refining Processes," Bulletin R-8

Bulletin R-8, just off the press, offers you 54 pages of technical text and data, flow diagrams and photographs that are not only authoritative — but timely.

Described are Thermofor Catalytic Cracking*, Houdry Catalytic Cracking*, Polyform and Gas Reversion, Alkylation, Isomerization and other processes for the production of 100 octane gasoline, aviation lube oils, butadiene and styrene for synthetic rubber, and many other important post-war refining processes.

Flow diagrams also cover combination cracking, viscosity breaking, delayed coking, gas concentration, propane deasphalting, furfural refining, solvent dewaxing, tannin solutizer sweetening, and other processes utilized in plants designed and built by Lummus. Bulletin R-8: "*Petroleum Refining Processes*" is ready for mailing. Write for a copy.

*Licensed by Houdry Process Corporation.

THE LUMMUS COMPANY

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Trail Blazing in the Skies

PIONEERING NEW METHODS

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BUILDING PROVEN AIRCRAFT PARTS

THE FAR-RANGING MARTIN PBM-3 is another of America's dependable planes built in part by Goodyear Aircraft. Large numbers of these long-distance patrol bombers now in service are equipped with ailerons, flaps and empennages fabricated by Goodyear. In building such components for the PBM-3 and other famous aircraft Goodyear has the advantage of its long experience and extensive research in all branches of aeronautics—a background that goes back to the very early days of aeronautics. This time-proved skill is further attested by Goodyear's standout record in building complete aircraft, including both the superb Corsair fighter and naval patrol airships.

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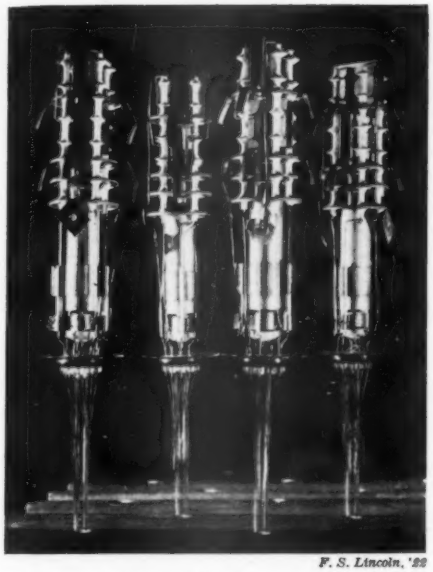
HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRCRAFT INDUSTRY

1. *By constructing subassemblies to manufacturers' specifications.*
2. *By designing parts for all types of airplanes.*
3. *By re-engineering parts for quantity production.*
4. *By building complete airplanes and airships.*
5. *By extending Goodyear Research facilities to aid the solution of any design or engineering problem.*

GOODYEAR AIRCRAFT



F. S. Lincoln, '22

Ballet: Cathode ray tube elements wait in a rack before being sealed in their glass envelopes at a plant of North American Philips Company.

VOLUME 46 NUMBER 9

THE TECHNOLOGY REVIEW

TITLE REGISTERED U. S. PATENT OFFICE

EDITED

AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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From a photograph by Fritz Goro

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Official United States Navy Photograph

Out of the Deep

THE
TECHNOLOGY
REVIEW

Vol. 46, No. 9 July, 1944

The Trend of Affairs

Wings After War

APPRAISED imaginatively and speculatively, aviation in the years immediately following this war is a wonderful wonderland through and above which Mister Public flits in his personal helicopter, shifting to roaring jet-propelled stratosphere ships for longer jaunts, skittering from place to place on the planet at will and at bargain rates. Such appraisals have glamour, if nothing else.

They have unglamorous characteristics, too, in that they easily lead to false expectations and hence to dubious prospects for public acceptance of what aviation is much more likely to be in the early postwar years. Appraised objectively and with a shrewd eye to economics and engineering, the future of aviation is seen to be tremendous in potentialities but subject to laws of growth not very different from those governing other industrial undertakings.

It is an appraisal of this second and very important kind which Lieutenant Commander S. Paul Johnston, '21, makes in *Wings After War*.* As readers of The Review have good reason to know, Mr. Johnston discusses aviation with all the interest and enthusiasm of a firm believer in what it is and can do but with the hard-headed common sense of one who has been closely concerned with its economic and engineering development over a long term of years. In this pungent volume, as in his articles for this magazine, his effort is to insure sound and untrammeled growth for aviation by safeguarding it against inflated and unstable anticipations.

Holding that the utility of the ordinary light plane is about the same as that of a motorboat of equal power and cost, Mr. Johnston reasons that the time has not yet arrived for the ocean of air that washes Everyman's doorstep to be made usable at the doorstep. Flying must be made simple enough and cheap enough to be indispensable to a large number of people. That Mr. Johnston believes it will be is implicit; he argues convincingly, however, that the process demands more time.

So it is with other aspects of probable postwar trends analyzed in other chapters of the volume — passenger travel, freight hauls, methods for the continued fostering of the skills in military aviation which the war has built up, the problem of disposing of the vast pool of aircraft which will be on hand when the war ends, and, germane to this last, the crucial question of government policy, on which the future of aviation as an industry hinges.

The upshot of any book such as this could easily be a very gloomy one. That this is not true of Mr. Johnston's volume is owed to the fact that he concludes with cogent argument for planning, for the furtherance of research, for devotion of talent "to consider the wave of the future before it engulfs us."

* New York: Duell, Sloan and Pearce, 1944. ix + 129 pages. $2.00.

Rolling Stock

SAVING 20 per cent in weight and allowing a slight increase in inside capacity, the first of a group of special four-wheeled railway cars for use in passenger trains has recently gone into service in England. Reinforced plastic sheets made of high-tensile steel wire and cotton mesh impregnated with synthetic resin under heat and pressure are used in the bodies of the cars, which were designed so as to employ the largest sheets at present available, six feet six inches by three feet three inches in dimension. In the manufacture of the sheets, 24 wires and threads are used to the inch and are woven so as to be interlocking. The material has an ultimate tensile strength of 12 tons to the square inch in each direction.

The body of the cars is separated from the frame by a spring cushioning system which permits the body to move longitudinally several inches under the influence of service shocks. The body frame is constructed of light channel sections, welding being used to fasten them to the rolled channels which compose the floor framing. The underframe is of cantilever design, built up by fabrication as

far as possible. Total weight of the car is 10.2 tons as compared with the 13 tons of similar vehicles of standard design.

Dictation by Telephone

BY DAVID O. WOODBURY

OF the millions of letters a day dictated by countless businessmen, a generous proportion are talked into dictation machines and later transcribed by stenographers. Modern dictation machines do a quick, neat job with the minimum of bother to the busy executive. Yet in large firms where there is much writing of letters this system may easily involve annoyance and economic loss which the machines themselves cannot overcome. This is because every executive must have his own machine ready to hand at all times, although he may not use it more than two or three times a day. The load factor under such conditions may be very poor — perhaps 10 per cent or less.

A large New York firm, for instance, has more than 600 dictating machines scattered about in as many offices. Squads of "runners" go around once an hour collecting wax cylinders and taking them to the stenographic bureau. Even if a record is unused, it must be inspected. This means some 4,200 invasions of private offices by subordinates who cannot help interrupting the occupants.

Henry P. Clausen has just patented a system designed to avoid this nuisance and improve the load factor to the theoretical limit. His scheme provides for the dictation of all letters over telephone lines to a central office, where they are fed to recording machines of a new type and thence transmitted to the stenographic bureau. According to Mr. Clausen it would be possible, in the firm above mentioned, to cut the number of machines from 600 to 60, working every machine virtually all the time. The exact number of record cutters needed for any office would be determined by statistical studies of the average number and distribution of letters on a typical day. Even with proper allowance for machines out of service and for emergency reserve capacity, an improvement of about 1,000 per cent in investment and upkeep of machines would result, not to mention savings in labor and avoidance of interruptions to busy men.

The Clausen recorder is a most ingenious device. The incoming telephonic dictation is first inscribed upon a magnetic wire loop of such length that it will hold about three minutes' worth of talk. Just ahead of the point where the sound is impressed on the wire is the demagnetizer which clears it for dictation to follow. Ahead of this, in turn, is the pickup device which takes the sound to the cutting machine for inscription on thin cellulose-acetate records. Thus the magnetic device acts as a temporary reservoir between speaker and final record.

In the normal course of events, dictation is carried on steadily, the loop of wire holding what it receives for three minutes, then feeding it into the recording circuit, then wiping itself clean. If the speaker wishes to listen to what he has said in recent paragraphs, he merely presses a button on his instrument, actuating a relay which disconnects the recording pickup and the wipe-off mechanism and plays the material on the loop back to him over the telephone line. To make changes, he then actuates the demagnetizer with a second button, clears the unsatisfactory remarks, and starts fresh. During such an interruption the turntable of the record cutter is stopped, so that no space is wasted. No sound track is cut until the speaker is satisfied with the language.

The system is separate from the ordinary telephone lines and has its own switchboard and operator. When an executive wants to dictate, he simply picks up a special handset and waits. The operator selects a line leading to an unoccupied recording unit and plugs in. The completed connection is signaled back by means of a green light, and the speaker goes ahead. Hanging up his phone indicates on the board that he is finished, and the operator pulls down the connection. A ticketing system insures that the records made will be identified with the office originating them.

Meanwhile, in the central recording room, an attendant is busy watching all machines. As records are completed, he removes them, groups them with the ticket sent him by the switchboard operator, and then sends them with other sets to the stenographic room. If a dictator fills more than one record, selector switches ganged to all machines connect one that is standing by. The attendant needs only to keep fresh records on all idle machines.

Clausen's invention also favors the stenographer with a similar double pickup device. If dictation is too fast, she can shut off the recording and play the words over and over again from the magnetic wire till she gets them. This avoids the time that would be lost in resetting the playing needle on the cut record, often difficult to do.

"Central station" dictation, besides its improved convenience, is expected to speed up letter writing and save large companies much money. An added advantage is that the records themselves, being only seven-thousandths of an inch thick, can be filed permanently in a small space for future reference. The cost of a record blank is about two cents. It will hold an hour's conversation on each side.

Cahotage

DRAMATIC improvement in cases of acute conjunctivitis treated with penicillin is reported from England, where application of the mold-produced drug is under investigation by ophthalmologists of the Royal Air Force. A drop of penicillin solution in each eye three times daily was found capable in some two weeks of clearing up inflamed, crusting, scaly lids with watery discharge, the condition having been present in some cases since childhood. ¶ Tractor-mounted shears are being used in logging operations in Texas. The shearing blades, placed around tree trunks, cut through them with one tug of the tractor, the felling operation requiring but a minute. ¶ Restriction of foreign supplies by wartime blockades has led to the development of an active pharmaceutical industry in Sweden. The refining of imported materials which to a great extent engaged the Swedish chemical industry in pre-war years has given way to the production of necessary medicinals at home. One of the prime purposes of the industry as now organized is the fostering of an export trade based entirely on production from domestic raw materials. ¶ Suburban women in Britain are reported to be spending three or four dollars a week on beauty treatments as against their average pre-war disbursement of less than a dollar in three weeks. Meanwhile in Australia, women must put their names on priority lists for six months to get cosmetics.

United States Fish and Wildlife Service

General Rattus

Possessed of Few Friends but Plenty of Ingenuity, Man's Match in Omnivorousness Continues a Problem

By Charles H. Blake

THE rat has no friends. It is almost the only well-known pest of which nothing good may be said. Even so, only a few other animals, notably the dog and the bear, have as great a wealth of legend associated with them as has the rat. These legends originally pertained to the black rat since even the story of the Pied Piper of Hamelin (1284) long antedates the invasion of the brown rat into Europe. Similarly, the story of the rat used as a sled by another rat in order to carry an egg goes back before the time when even the black rat was recognized as a pest, although it was known to the Greeks.

To speak of "the rat" is not strictly true. There are many kinds of rats in various parts of the world and the term is, in fact, rather a convenience in separating the larger ratlike rodents from very similar rodents which are smaller and are called "mice." In the United States, we are more or less justified in speaking of "the rat," since the only common domestic rat is the brown, or Norway, rat. In other parts of the world, other species occur which, though not always closely related, are sometimes sufficiently exclusive in an area to be thought of as "the rat." The brown rat and its allies in the genus Rattus furnish the most destructive of the household rodents, but they are in some respects rivaled by the closely related though much smaller house mice of the genus Mus. All Old World rats and mice which are common in the United States, belong to the family Muridae, whereas our common American native rats and mice belong to the Cricetidae.

Rodents are surprisingly easy to domesticate — so easy, in fact, that they tend to domesticate themselves. I suppose this arises from the fact that many of them can live in very cramped quarters such as are found within walls of a building, can go through narrow passageways, are shy, alert, and, above all, nocturnal, and hence rarely come into actual contact with their hosts (human beings).

Rats resemble man in more than one way, and not the least of these is that both are nearly omnivorous — rats, in fact, are so omnivorous that they are much more easily baited with meat than with grain. Undoubtedly, this willingness to eat almost anything has helped adapt the genus Rattus to live with man. However, the characteristic must have developed long before rats were associated with man. It is strongly reflected in the structure of the digestive tract, which is shorter than that of some other types of rodents, such as guinea pigs, which are fairly exclusively vegetarian. This shortness is particularly marked in the blind pouch (caecum) which juts out from the junction of the large and small intestines. In the leaf-eating rodents, the caecum is relatively enormous, sometimes having a capacity equal to that of all the rest of the digestive tract and being as long as the small intestine.

No complete list of the domestic and semidomestic rodents of the world exists as far as I know, but we do have fairly complete accounts of Mus and Rattus. The latter genus seems to have its headquarters on the larger islands of the Dutch East Indies, where rather many wild species occur. In Sumatra, for example, there are about 30 species, but the number of species declines very rapidly east of the Celebes and north of Malaya and the Philippines. Apparently only a few of the species have become domesticated. One of these, *Rattus concolor*, is recorded from Burma to New Guinea. It seems nowhere to be highly significant. The brown rat (*Rattus norvegicus*), which is now cosmopolitan, is known by many names. It is a large gray-brown animal, although its size depends to some extent upon food supplies during growth. Hence it is often supposed that there are several kinds of brown rats. The

brown rat affords one well-marked variety, the albino rat of the biology laboratories. This is a small race which is said also to be minutely different in its structural characters from the main form and to be relatively tame. We must, in the case of these rodents, distinguish between a domestic animal and a tame animal.

The theory is that the brown rat gradually spread both eastward and westward from its original home somewhere in central Asia. Its westward spread, however, was relatively recent. The first recorded westward invasion of the brown rat was its crossing of the lower Volga in 1727, although it seems certain that it had earlier appeared, at least in small numbers, in Russia. It reached England about 1729, apparently by water because it did not arrive in eastern Germany until 1750. It first appeared in North America in 1775.

For a long time it was known in England as the Hanoverian rat since it was first observed in England during the reign of George II of the House of Hanover. Because it arrived in England so recently, we have been able to see there more clearly the relations between the brown rat and its somewhat smaller relative, the black rat, or ship rat, which is the old house rat of the British Isles. When the two species come into competition, the brown rat displaces the black rat, except in those situations in which the black rat can keep out of the way of the brown rat by climbing. The brown rat does not climb to any great extent.

The brown rat is a powerful animal, quite capable of enlarging openings in brick and poor concrete with its strong front teeth. The most recent recommendation I have seen for the flooring of chicken houses is to use four inches of reinforced concrete. This is said to be ratproof. Brown rats can easily tear open many kinds of packages, damaging much that they do not eat. Like their relatives, they make nests of fiber or shredded paper or cloth. Here the young are born and raised until the time of weaning. They become sexually mature in about two months.

The brown rat possesses surprising ability to learn how to avoid poison baits. Both the base food and the poison must be changed at intervals. Prebaiting with clean foods for several nights before use of poison baits is often needed to get good results. This rat is very trap shy.

The roof rat, *Rattus rattus alexandrinus*, is practically cosmopolitan but, unlike the brown rat, is divisible into at least eight distinguishable domestic forms, some of which are very local and others of which are found almost throughout the world. Generally speaking, it is a little smaller than the brown rat; much darker in color, sometimes practically black; and a good climber, preferring to live in the upper parts of buildings (hence the name "roof rat") and in trees. Otherwise its habits are similar to those of the brown rat, but it is generally a much weaker animal. It is characteristically the rat of ships. Three of its forms occur more or less sparingly in North America — the roof rat proper, the white-bellied roof rat, and the black rat, or ship rat.

The house mouse, as a species, is likewise cosmopolitan. Ernst Schwarz recognizes no less than 11 domestic forms of this animal. No one of these is cosmopolitan and a few have very restricted distributions. For the most part, in Schwarz's opinion, these domestic forms are accompanied by very similar wild races. This theory raises the troublesome question of the effect of domestication upon the house mouse, and there is no satisfactory answer available at this time to my knowledge. The house mouse, like the brown rat, has a well-defined albino form, and a few other variants have been obtained. As far as I know, these are strictly identical with one or the other of the two chief European forms, *Mus musculus domesticus* and *Mus musculus musculus*. The forms found in North America are *Mus musculus brevirostris* and *Mus musculus musculus*. The former, a southern type, is the only representative of the species in Central and South America. The latter is the ordinary northern form. It reappears in Australia and Tasmania but is replaced by still another form in the temperate portion of South Africa. It is an interesting speculation whether the distribution of these 11 forms would shed light jointly upon the travels of man and upon the relative times of introduction of the different forms into regions outside the old homeland of the species, which is probably South Central Asia.

The house mouse differs from the rats in one very useful characteristic: It likes somewhat sweet materials and is, therefore, comparatively easily baited with grains and with peanut butter. Also, it is not very intelligent and not at all trap shy. House mice are often trapped in agricultural areas, along with native American mice, but the house mouse normally is a house dweller. In the northern United States, at any event, the control of the house mouse is considered a relatively simple matter in comparison with the control of rats.

Many estimates have been made of the damage done in the United States each year by domestic rodents, but they are only estimates. I think it may be agreed that the figure in any event runs into hundreds of millions of dollars. Estimates of the number of rats in the United States have also been attempted. Personally, I should not want to set the figure at less than twice the total population of human beings, but a census even in a very limited area is extremely difficult. It has been stated, for example, that in surveying for rats one may assume that the total rat population is never less than twice the largest number of rats that can be seen, and in many locations it has been proved to be far greater. For instance, a farmer may see two or three rats around a chicken house, but if, under appropriate safeguards, he tips the chicken house over, he can expect to get from six to ten rats.

In the literature are many statements of the fecundity of the rat. Within limits they are true — that is, that a grown pair can produce some six or more broods of young a year with as many as 10 or 12 in a brood. If one works this out, one gets staggering totals. The difficulty with such amusing calculations is that they fail to take into consideration various factors: in the first place, mortality before maturity, which we may estimate to be at least 50 per cent; second, the almost certainty that the number of broods is nothing like maximum, perhaps no more than two or three a year; and third, the fact that prenatal mortality is probably greater in the wild state than in the laboratory. I therefore submit my own estimate that the increase of a pair of rats under natural conditions will amount to something like 36 a year; in all conscience this is bad enough.

Domestic rodents are also associated with the carriage of a number of important diseases. Of these, the most famous is plague, which attacks rodents and is carried by rodent fleas from one animal to another or to man. The Review for January contained a brief discussion of plague in the United States.

Although plague is very widely distributed, it is relatively rare in man and rodents outside of eastern Asia. It is by no means certain how far the plague had traveled before the advent of modern commerce. Great epidemics of it reached Europe in the Middle Ages; whether they went also to the southeast is uncertain. At least one author claims that New Caledonia is an ancient focus, but certainly there is no other in the Pacific islands.

A number of other diseases of importance are carried by domestic rodents, and some of these are described briefly below. Weil's disease, or infectious jaundice, is marked by a disabling fever often accompanied by jaundice and numerous small hemorrhages of the skin and internal organs. Although we have not very often heard of Weil's disease except during World War I when it harried the trenches, it is probably widespread — especially in the Northern Hemisphere — though often it may not be recognized as such. The causative organism rejoices in the jawbreaking name of *Leptospira icterohaemorrhagiae*. It is about 4/1,000 inch long, and the body is a coil of about 16 rather close turns. In nature, this seems to be a disease of rats and has been most frequently noticed in persons who come in contact with rats or places inhabited by them — for example, slaughterhouse workers, coal miners, sewer workers, and quarrymen. No vector is known, and it is still uncertain how the spirochete gets from rat to man. It is especially likely to be found in the urine of diseased animals.

A disease resembling Weil's disease in some ways is ratbite fever, or sodoku. It too is transmitted directly from rats without a vector and it is largely restricted to the Northern Hemisphere, but in other respects it exhibits striking differences from Weil's disease. The disease begins with an ulcer at a spot bitten by a rat. This is followed by a fever of the relapsing type and sometimes by a spotty, reddish rash. The causative organism is variously held to be a peculiar spirochete or a bacterium, and it goes by several names, such as *Spirochaete morsus muris* and *Spirillum minus*. It is not out of the question that two different organisms causing similar disease are involved.

Although John Citizen is more apt to associate rats with plague and infectious jaundice, we should really stir him up about food poisoning. He may be in the trenches once in his life, if at all, and probably will never visit a plague-ridden country. On the other hand, he eats food every day and often knows little of the conditions under which it is produced. Food poisoning is a term covering a multitude of sins but is properly applied to acute disease due to infection with one or more kinds of bacteria included in the genus Salmonella, which is the real villainess among the bacteria associated with rats. Nearly 40 species of these bacteria are known, causing various diseases in various animals. Certain species cause paratyphoid and food poisoning in man.

The normal process of transmission is for food or drink to be contaminated by bacteria from an already infected individual, either man or rodent. This food, eaten by a susceptible animal, will normally cause a new case. The English authority on food poisoning, Sir William Savage, stressed the role of rodents in contamination of food. His contention was based to a great extent on the frequency with which mouse feces were found associated with food products, not on a direct tracing of bacteria to mice or rats. I suggest that the most important sorts of conveying foods are those made commercially, not tightly wrapped immediately after cooking, and eaten without further cooking. This accounts for the prevalence of food poisoning from cream puffs and similar pastry products. Henry Welch, M. Ostrolenk, and M. T. Bartram in 1941 made the cautious statement that "since some few rats or mice may be infected with food poisoning organisms, they all must be considered potentially dangerous to health, and every effort should be made to eliminate them from establishments where human food is prepared or stored." The lesser frequency of such infection in the United States as compared to England is due in part to our much greater use of refrigerators for food storage.

Rats and mice serve as reservoirs of food-poisoning bacteria. Mechanical spreading of the bacteria could probably be accomplished by food-infesting insects.

The relatively mild disease called endemic or murine typhus is largely confined to the South Atlantic and Gulf states. To it may be assigned most of the nearly 1,900 cases reported as typhus in the United States in 1940. Not only the domestic rat but also various wild rodents are found infected. In the wild rodent, the disease is comparatively mild — a fortunate fact, since animals suffering from a mild disease or a slow-acting poison usually crawl into their holes to die, and the fleas infesting them are thus informally buried instead of being set adrift where they would be picked up by people. Plague, on the contrary, most often means sudden death to the rat and therefore liberation of its fleas where they may readily infect man. Workers of the United States Public Health Service and others have stressed the tendency of this disease to be concentrated in urban areas, which fact points to the assumption by domestic rats and mice of a dominant role as reservoirs. The vectors are various fleas and the tropical rat mite, *Liponyssus bacoti*. (*Continued on page 560*)

United States Fish and Wildlife Service

Essential to control of the rat is the elimination of "rat harbors." A simple example is shown here. At the left, lumber and odds and ends, loosely piled, make a perfect hideout for Rattus. At the right, piling the lumber high off the ground is a proper start toward elimination of the harbor.

The Oil Situation

The Demands of War Place Greater Emphasis on Augmenting the Supply of Petroleum

By Roland F. Beers

EVERY day the past 12 months the civilian and military demands of the United States required the production of more than 4,000,000 barrels of petroleum. Last year's consumption totaled more than 1,500,000,000 barrels, 8 per cent more than in 1942. At the end of the year, average daily production was a half million barrels more than that of a year ago, an increase of over 14 per cent.

To find the real significance of these figures challenges one's imagination. Five-gallon cans of gasoline stacked on end until they reach the moon do not mean much, but examples of the use of petroleum as fuel by our armed forces do. Of the great tonnage of military personnel and equipment transported overseas, 65 per cent of all shipping is allotted to petroleum products. Six hundred thousand barrels of gasoline — one-third of our total production — are being taken by the military every day. This would be equivalent to 5,000,000 B coupons. Our armed forces require approximately 50,000,000 gallons of gasoline, fuel oil, lubricants, and other products of petroleum *every day*. In 1942, our Navy consumed over 1,000,000,000 gallons of oil; in 1943, it required twice that amount; and during the present year, it will use a great deal more.

A thousand planes making an attack on central Germany consume more than 1,000,000 gallons of gasoline and 30,000 gallons of lubricating oil, enough to supply over 10,000 A-card holders for a full year. One mechanized Army division with a total horsepower of nearly 200,000 will burn 18,000 gallons of gasoline each hour it is on the move. Every Flying Fortress starts out with not less than 500 gallons of gasoline in its tanks. The Navy's new fighting Hellcat burns as much gasoline in one hour as it would take to drive a car from Boston to Dallas, Texas.

Civilian consumption of gasoline was reduced by the Petroleum Administration for War to 1,117,000 barrels a day in the first quarter of 1944, a decline of 38 per cent from normal peacetime civilian requirements. The gasoline supply for the civilian motorist in 1944 will not increase, according to present estimates of military demand. It may actually decline. Consider the fact that three pounds of gasoline are needed to deliver one pound of bombs filled with petroleum explosives and the fact that to date we have produced more than 1,600,000 tons of aerial bombs. With an all-out invasion of Europe in progress and a full-scale offensive in the Pacific likely in 1944, it is easy to foresee what will be required in petroleum and its products.

Our ability to produce enough oil to meet all requirements may be estimated from a glance at the nation's reserves: In storage above the ground in January, 1941, we had approximately 263,000,000 barrels of crude oil. By January, 1944, these stocks had declined to 249,000,000 barrels. The corresponding figures for heavy fuel oil stocks are 86,000,000 barrels in January, 1941, and 54,000,000 barrels in January, 1944. Gasoline stocks of 90,000,000 barrels in January, 1941, fell to 78,000,000 barrels in January, 1944. Light fuel oil stocks showed a slight gain: 37,000,000 barrels in 1941 as against 39,000,000 barrels in 1944. Expressed in the number of days' supply on hand, we had in January, 1941, 72 days' supply of crude oil, 104 days' of heavy fuel oils, and 50 days' of gasoline. By 1944, these figures had shrunk to 58 days' supply of crude, 42 of heavy fuel oils, and 40 of gasoline.

If existing reserves cannot be produced in sufficient quantity to meet current demands, what of the coming year, and the next? Some operators foresee a daily demand of 5,000,000 barrels in 1945. At present we are having difficulty in producing 4,500,000 barrels a day, and the most optimistic outlook for this year does not exceed that figure. A daily deficit of 500,000 barrels of petroleum is no trifle. Where will it come from?

There are two possible sources of additional oil: One is foreign fields, the second is new discoveries in the United States. Foreign oil can easily fill the immediate demand. Some of it must be imported to the United States and processed here. Inadequate refining facilities now exist abroad, particularly for special products such as high-octane gasoline and butadiene. If there is a deficit of 225,000,000 barrels in United States production in 1944, the Petroleum Administra-

Pure Oil Company

Photographs by R. I. Nesmith suggest the trials of petroleum hunters. Here a seismograph party sleds its boat along a bayou in Louisiana swamps. Head nets protect the men against malarial mosquitoes.

Pure Oil Company

The party's surveyor takes an alidade reading.

tion for War will probably supplement United States production with this amount of foreign oil. About 70,000,000 barrels will be received from South America for United States refineries. A total of 140,000,000 barrels will be produced and refined abroad. The remainder of 15,000,000 barrels may be taken from United States stocks.

Whether or not these plans will meet all requirements depends upon our ability to produce this quantity of foreign oil, process it, and deliver it to our fighting fronts. Many hazards lie ahead in 1944 and 1945. To assure a foreign oil supply, American drilling crews and equipment must be sent to South America and other producing areas. United States producers will not willingly part with their already depleted supply of skilled oil-field workers and equipment. Although 150 new power rigs will be acquired by the industry in 1944, serious bottlenecks will remain in critical components later this year. Further hazards confronting the program are the submarine menace to tankers which must supply the European invasion and the difficulty in maintaining the present high level of domestic production under difficult conditions. Maintaining domestic production (and increasing it if possible) is extremely urgent.

It is generally agreed throughout the industry that we can produce 1,600,000,000 barrels of oil in 1944 provided certain difficulties now in the way are removed. One of the issues to which the industry and the press have recently given much attention is the price of crude oil. The average price of crude as determined by the Office of Price Administration in November, 1941, is $1.18 a barrel. This figure represents a range from 65 cents to $3.00, depending upon the quality of the crude. Producers have asked for an initial increase of 35 cents a barrel. Admittedly this is only the beginning of an upward price adjustment. There are many separate effects which such an increase might produce.

Independent producers, and particularly operators of stripper wells, contend that their reserves are being depleted at less than replacement cost and that present prices compel a shutdown of small wells which might be continued in production by secondary recovery methods if a sufficient return on the expense were available. Three-quarters of the 410,000 producing wells in the United States are strippers, accounting for 15 per cent of the total daily production. These small wells may produce five barrels of oil a day or less, and if their abandonment during 1944 could be retarded in any way, 2,000,000 barrels of oil would be added to the year's supplies. While this is only 1 per cent of the coming year's deficit, it may prove to be worth while.

Although an increase in the price of crude may not be justifiable on strictly economic considerations, the effect of an increase would be of unquestionable value. In the past, price increases have always resulted in the discovery of new reserves. The relationship is complicated, and usually there is a delay of from one to two years after price increases before new reserves are proved. At least one student of this problem predicts that the requested price increase of 35 cents a barrel will not result in the discovery of enough petroleum to meet 1945 demands.

A 35-cent rise would cost the country about half a billion dollars at the well, increase the consumer price of gasoline about one cent a gallon, and double the gross profits of many oil companies, according to Fred M. Vinson and the Office of Price Administration. He suggests, therefore, that operators of stripper wells be subsidized; but any such idea is repulsive to the independent oilman, who will neither ask nor take favors from anyone. If the price of crude were increased from 50 cents to $1.00 a barrel, it might be possible to produce an additional three to five billion barrels of oil from these stripper wells at the rate of 18,000,000 barrels a year. The O.P.A. argues that government subsidies would encourage secondary recovery projects, such as repressuring or water flooding under high pressure through key wells. In Pennsylvania these methods have been used for more than 20 years in the Bradford field, where water flooding has produced about 200,000,000 barrels of oil otherwise unrecoverable.

Pure Oil Company

The drilling crew is jetting a shot hole in the bayou bottom for the location of an explosive charge.

Pure Oil Company

The seismograph recording crew with their instruments at work in flat-bottomed bayou skiffs

All this money would probably produce more oil at an earlier date if it could be spent in the drilling of new wells. Many oil producers contend that as much oil could be taken from wells spaced one to every 10 acres as by closer spacing. Recent drilling regulations of the Petroleum Administration for War have required wells no closer than one to every 40 acres. In recent months, however, experiments have shown that closer spacing of wells will result in increased immediate recovery. Additional new wells in between old producers might thus lead the way to a rapid increase in daily production.

The Petroleum Administration for War has requested the industry to drill 19,000 of these development wells in 1944. We shall be lucky if this number can be drilled. There is now a net shortage of 10,000 drilling workers who have left the oil fields for other war industries. Many have gone into military service. Increasing allotments of steel will provide for the rehabilitation of existing drilling rigs, but the operation of this specialized equipment by inexperienced crews will result in many breakdowns and a lowered drilling production.

In addition to purely development wells, the Petroleum Administration for War wants the industry to drill 5,000 wildcats this year. If the stakes appear high enough to men of courage in wildcatting, then certainly some activity will follow a substantial price increase. This is the factor in oil production that defies economic laws and formulas. For some reason or other, whenever the game gets hot enough, a handful of characters of Paul Bunyan dimensions appears in the hunt. These boys are the ones who have discovered some of the largest fields in the United States. There is no accounting for their behavior, and it may be that we pay special attention to them solely because of their gigantic prowess. For every one who discovers an East Texas, hundreds lose their shirts and are never heard of. Nevertheless, they constitute an important economic factor in the discovery of new oil.

With the support which the major companies lend, these wildcatters drill holes in places where no scientific justification therefor can be discerned. Even though such a hole produces no oil, it contributes to the general geologic knowledge of all potentially producing provinces and narrows the hunt to the ultimate areas of production. Much exploration goes on in secluded offices of oil companies under the eyes of men who do little else than study the rock cuttings of dry holes. Through examination of the rock samples brought up by the drill and correlation of them with other wells in the area, the subsurface geology of each province is gradually unraveled. Long ago geologists learned to look for oil on structures which were apparent at the surface. Today most of these promising prospects have been drilled. The search must now be made with more precision and finer tools. Save for the rapidly developing Rocky Mountain area, we cannot expect that many oil fields will be found from their surface expression.

That the wildcatters have discovered a great many very large fields does not necessarily mean that they have found most of the oil in the United States. Beginning about 1920, scientific methods were employed in the search for oil; they have gradually developed until they have practically taken over the job of providing new reserves. The techniques are now so complicated that petroleum geologists no longer assume full responsibility for the task, and the array of scientific talents assembled for this work is impressive. Physicists, chemists, electrical engineers, mathematicians, bacteriologists, biologists, paleontologists, mineralogists, petrographers are some of the specialists who devote full time to the problems of finding oil. Field crews may be composed of any of these men plus a greater number of mechanical and civil engineers, surveyors, drillers, dynamite shooters, truck drivers, pumpers, and helpers of all kinds. Three hundred and fifty of these crews, numbering up to 15 men per crew, are now at work throughout continental United States in search of oil. The total annual outlay for exploration now exceeds $350,000,000. With the discovery of 1,500,000,000 barrels of oil a year for the past few years, this means that it costs roughly 25 cents to find a barrel of oil. In 1943 this cost was increased, as the amount of new oil found that year declined to just slightly more than 1,000,000,000 barrels.

This decline in new discoveries has been going on now for several years. It is a matter of great concern to the industry at large and particularly to the small group of men who are charged with the responsibility of finding new oil. Because of the reluctance of wildcatters to carry on their exploration activities at the current price of crude, the emphasis on exploration has been shifted to the major oil companies, who are now operating their exploration crews at an all-time high. The result of this intense activity is an actual increase in the number of new fields discovered each year. In 1936, a total of 162 new fields were found; in 1943 the number was 348. The total reserves of the 1936 discoveries amounted to 2,400,000,000 barrels, while those of 1943 were only a quarter billion barrels. The reason for this decline in the volume of new discoveries is shown from the average size of field discovered. In 1939 this amounted to 5,600,000 barrels; in 1942 it was 1,200,000 barrels. Undoubtedly more new oil could be found by all scientific methods if the rewards of discovery could be increased. Many areas are not being explored because the cost of exploration is greater than present returns would warrant. (*Continued on page 566*)

The Teacher's Task

Not Training, but Education toward Attainment of Spiritual Freedom, Is the Primary Goal of the School

By B. Edwin Hutchinson

Recently in Detroit the National Association of Manufacturers and the National Education Association joined in sponsoring a Conference between Industry and Education for discussion of problems and projects of mutual interest. This essay is drawn from an address Mr. Hutchinson delivered at the conference. — Ed.

IT is rather the fashion of late to play down individuality and refer to people by classes. We hear a lot about the industrial interests, the farm bloc, labor, the youth movement, parents' associations, the teaching profession, Wall Street, what the East thinks, what the southern point of view is, and so on — until one begins to wonder just what area of thought, action, or interest may be left for you and me as just plain folks. As a matter of fact, this very gathering has more than something of a collectivistic approach in that it is avowedly an organized effort to bring about a better understanding between educators and business people as classifications of citizens.

In a way, the necessity for such a meeting as this is unfortunate. In the simpler days of our forefathers, when communities were smaller, we should all have known one another as a matter of course. Knowing each other on a more or less intimate social and personal basis, we should have found that most of the problems now said to exist between teachers and business people, as classes or groups in our social order, either never arose or were readily worked out. As it is, I am not exactly certain what these problems are, much less what the answers may be. Under these conditions, it seems high time we did get together and find out what it is all about.

The primary purpose of this meeting, as I understand it, is that we get to know each other as individuals, and with this end in view, we are shortly to break up into small groups where we shall have an opportunity to talk back instead of just being talked at. I am looking forward to this experience, because in my recollection this is the first time I have ever been encouraged to "talk back" to a schoolteacher!

I must say, however, that I approach this experience with all and more of that attitude of respect with which I approached my teachers as a child, but for quite a different reason. I have come to regard teaching as the most fundamental and essential activity in life. Without it, no phase of what we cherish as our civilization could be perpetuated beyond the present generation. Of course in a sense, we are all teachers, just as we are all students, or should be if we expect to continue to grow and expand. To you who have elected to adopt teaching as a life's work, however, it must be a particularly soul-satisfying experience to realize that you are entrusted with the prime responsibility for inculcating into the minds of the young those ideas, those attitudes and values, which are at once our heritage of the past and the foundation for the future.

Right here might be a good place to divest myself of the principal observation on education which I shall make in the course of this talk, and at that it can be only a suggestion: It seems to me our modern educational approach does not sufficiently differentiate between "training" and what I choose to call "education." It tends to put undue emphasis upon training to the neglect of real education.

The end objective of education is the making of men and women, in the highest sense of those words. Education is the inspiration and guidance of childhood through youth to a rounded maturity of adulthood. For education to be truly successful, its end product must be men and women who have developed character at the same time that they have acquired knowledge. We can train animals, but the education of a man is a human awakening. The prime goal of education should be the eventual attainment by each individual of an inner spiritual freedom, the liberation of the individual from the bonds of ignorance and prejudice through the acquisition of knowledge and wisdom. Specific training in the arts and trades helps the individual to lead a normal, useful, and co-operative life in the community, but this, it seems to me, is not the primary — it is a secondary aim of education. When the primary emphasis of educational activity is diverted to such avowedly utilitarian ends as mere training, it can, and on occasion does, degenerate into such evil manifestations as the nazi youth organizations and training schools, where all sense of truth in the human mind is smashed, all moral values are perverted, and the individual is relegated to the position of being merely a part of the technical equipment of the state.

The good society is that in which free men individually acknowledge their responsibility to conduct themselves under laws of their own devising in a manner which accords due respect to the rights and dignity of all others. It is the practical application in the political and economic fields of that moral principle so widely known and so little practiced, the golden rule. Historically, this seems to have been most nearly, though as yet imperfectly, attained in democracies, and the best example of it so far is to be found in these our own United States.

The whole idea, however, is currently under challenge, and the greatest war in all history is now being fought on the issues it raises. If the outcome is not still in doubt, it nevertheless remains a fact that the world has had a pretty close squeak. Furthermore, there are plenty of differences of opinion right here among us in this country about how things ought to be run — enough to furnish material for several evenings' discussion.

Now it has been by no inadvertence but by cool design that I have led this discussion into deep and troubled waters. I have suggested questions of momentous import, and I have done so because these questions will have to

be dealt with by these same young people you are now engaged in educating. I am suggesting to you teachers that the real problem to be faced in your field is not how we can train more and better plumbers, doctors, mechanics, lawyers, engineers, and what not, but how we can rear successive generations of free men and women with the courage, the vision, and the wisdom to preserve, cultivate, and improve the finest heritage mankind has yet devised. Today this is a weary world and full of trouble. It is largely engaged at the moment in its own destruction. Much investigation is needed to learn how it got this way; what can be done to stop this mass suicide of the human race; how repetitions of this sort of thing can be avoided in the future; and, most urgently and particularly, what had best be done here and now in the interests of our own country.

These are the sorts of questions with which the boys and girls you are now teaching will have to deal successfully, much more successfully than our generation has been able to, if the way of life the advantages of which you and I have enjoyed is even to endure, to say nothing of the future realization of the dreams of the America that you and I have envisioned.

The laboratory, the manual training classes, the cooking schools, have their place in your educational paraphernalia as educational tools to impress the minds and imbue the souls of the young with the fact that this is a material world in which we live and that there are practical problems in it with which we must deal. All this is important, for some of the most troublesome people with whom the world has to contend are those impractical dreamers who attempt to cope with the problems of life as mere theoretical abstractions; yet the utilitarian aspect of the educational technique must be kept subordinate to what seems to me to be the ultimate fundamental objective of education — the making of men of character and good will.

Now I have practically used up my time talking on education. One is apt to talk most freely on subjects about which one knows the least. I am featured on this program as a representative of industry, and I find that I instinctively approach a discussion of that subject with much greater diffidence.

Let me say at the outset that I am well aware of some of the criticism that from time to time is leveled at industry by educators and by many others. Criticizing industry is one of the favorite national pastimes, widely practiced during the past 12 years particularly. I can't begin at this time and in these circumstances to respond to all the indictments drawn against business or to analyze all the doxies proposed for its regeneration. Our various political contenders may be confidently relied upon to do that for us, and with great sound and fury, if not intrusiveness.

Historically, the demagogue has for his own advantage always sought to tear down the existing order rather than to strive for its improvement, and there are those among us today who are eagerly resorting to this historic pattern. Their appeal is to ignorance, selfishness, and hatred, and the only effective counter to their disruptive influence is the cultivation of an intelligent love for truth and of an attitude of good will toward one another. Such an undertaking is the peculiar province of our teachers, secular and religious, and too little recognition has been accorded this fact by most businessmen, among others.

When we contemplate business activities and all other activities — social, educational, political, religious, or what have you — we must differentiate carefully between the functions served and the personal practices and proclivities of those individuals serving them. There are just as many different kinds of businessmen as there are different kinds of teachers. There must be. We are all just ordinary human beings, grown up in the tradition of Americanism, the product of America's educational system. As such we are pretty good as mankind goes but still subject to improvement.

The function of business and industry, on the other hand, is quite impersonal and wholly objective. In ordinary peacetime, that function is the organized production and exchange of goods and services. It is an important segment of human activity, as are agriculture, education, politics, and soldiering. Relatively speaking, industry has increased in importance over the past century and a half as compared with agriculture because the mechanization of farm work has enabled us all to get enough to eat if one man out of five will work on the farm whilst formerly the task required four out of five. During the past two or three years, soldiering has become relatively more important than either agriculture or industry; so we are all getting along with fewer things.

We find we can change things around a good deal as the necessity arises, and we make up our minds to do so. Our factories are now making munitions of war and our schools are now largely devoted to the training of soldiers and sailors. The instrument by which these changes are accomplished is an institution called "government," which in time of war becomes even more than ordinarily important. The people who work at government are called "politicians" unless there get to be so many of them that they just have to mess into other people's business to find something to do, in which event they are called "bureaucrats"; or unless they become very good at their work, in which event they are called "statesmen," though that designation is seldom applied until after they are dead.

During this war emergency we have all cheerfully submitted to varying degrees of governmental regimentation and direction of our activities, industrial and educational, all for the purpose of promoting the war effort. There are those among us who feel that some fundamental change in the freedom which has characterized our way of life in the past is desirable. I for one, and most of us, I hope, are not sympathetic to permanent change in that direction. We prefer to work out our destiny on a more American basis.

We hear more or less about a "planned economy," but the question seems to be largely who will do the planning — the government bureaucrat or the people. American industry has been built with capital accumulated through the thrift of our people and expended by those with the vision to plan for the satisfaction of the people's needs and desires. The services of American business are assayed in the competitive markets by those same people, its customers. Do not overlook the fact that a government which plans what industry will produce also plans what the people will buy, and where people will work, and, if you please, what teachers will teach and how they may teach it! Industry is solidly against this idea, which the demagogue misrepresents as progress but which history discloses as reaction. The great- (*Concluded on page 574*)

Romance Along El Camino Real

By Neill James

En route to Mitla on the Pan American Highway in the Mexican state of Oaxaca

THE binding together of the peoples of the peace-loving Americas by a fragile ribbon of highway rather than by conquest of arms is a concept to stir the imagination of man. As the Pan American Highway nears completion, new riches of understanding and interest will be available to the varied peoples whose lands the road traverses.

The idea was not original. Centuries before Cortes and his Spanish conquistadors arrived in the Western Hemisphere in 1519, the Indians had already realized their primitive version of a Pan American Highway, a *camino real* (royal road). It was a dry-weather trail winding over mountain passes and penetrating tropical jungles, but it suited the needs of a prehorse age when man was his own burden bearer. Caravans of Zapotecan and Mixtecan Indian traders accompanied by their *cargadores* (bearers) traveled on foot through Central America all the way to Peru to barter wares with the Incas. Cortes found it expedient to control this trade route. To this end he conquered and fortified Oaxaca, seat of the Zapotecan civilization. He enforced the Spanish custom of discouraging communication between villages, to keep unwilling subjects disunited. The effects of this act have not been eradicated even in our own times. Today, only about 3 per cent of Mexican villages are connected by any sort of motor road.

The plan for a Pan American Highway drawn up a quarter century ago was grand but practical. As planned, the main route extends from Alaska in the North to Patagonia in the South and runs the gamut of latitude and altitude. Each of the republics to be traversed by this international highway agreed to construct a linking road from border to border. The distance between the official termini — Fairbanks in the North and Rio de Janeiro in the South, via Valparaiso and Buenos Aires — is just 15,494 miles, something more than halfway around the earth as the crow flies. It is the longest highway in the world.

By 1930 work was under way, proceeding in a normal, leisurely fashion. Although the benefits to the American republics were to be incalculable, there was little haste in opening this wonderland to travelers. War shocked the Americas into the realization that the Pan American Highway was their own unfinished Burma Road. There followed a spurt of effort to complete the highway. In the North, Army engineers and bulldozers crashing the underbrush from north and south met in the Yukon wilderness in November, 1942. Shortly thereafter Army supply trucks were rolling over 1,671 miles of pioneer road linking the United States, Canada, and our territory of Alaska. Today 95 per cent of the entire Inter-American Highway is in active use. The principal bottleneck is a 290-mile length in Ecuador, with a few difficult mountain stretches yet to be mastered in Nicaragua and Costa Rica and one in southern Mexico.

In a mountainous country with abundant cheap labor, an unpaved highway is not the headache it would prove to be in our own country. In Guatemala, where the entire 300-mile length of road is graveled, one million Indian citizens prefer to work for two weeks each year on national highways rather than pay the $2.00 annual tax. I watched them deftly filling and tamping gravel in chuckholes with rude wooden mauls. They had no machinery, not even a lowly wheelbarrow. Hundreds of men clad in hand-woven costumes carried dirt and gravel in boxes upon their backs.

One must regret that even the most imaginative future traveler who has not been an eye witness to some of the work cannot conceive of the titanic task involved in the construction of this trade artery of the Americas. Engineers maneuvered impossible mountain grades, bridged roaring rivers, crossed dank tropical jungles. Much of this labor was without benefit of road-building machinery. The war, of course, delayed or cut off the flow of spare parts for the already inadequate machinery. An instance of the inventive genius in bridging such gaps in material is the job in Nicaragua, where engineers in search of a substitute material for clutch and brake linings found it in lignum vitae, the unusually hard, oily native wood which grows abundantly in Mexico and Central and South America.

As late as last summer the trip from Mexico City to Oaxaca could be made only over a narrow-gauge railway or by air. The gap in the highway between Tehuacán, where the pavement ends, and Tehuantepec was mostly in the blueprint stage. In company with two mining engineers, I traveled over a section of this projected road when it was in the roughest stage of construction, barely passable. We went to a point some 80 kilometers northwest of Oaxaca, where workers who live in adjacent districts received ₱1.50 a day [1] plus overtime which increased the average daily wage to about ₱3.00 (60 cents in United States money). This was considered "inflationary" by rival bidders for labor. Contractors fared better financially than workmen. One Oaxacan contractor made a profit of ₱80,000 on a four-kilometer length of road construction.

I watched a thousand white-clad Indians literally carving the tops off green mountains, filling in steep valleys by hand. It was a dramatic sight. The single piece of

[1] In United States money, a peso is about 20¾ cents; five centavos equal a cent. Hence, $1.00 equals ₱4.85; ₱1.00 equals 100 centavos.

machinery on the job, a crane, bit out five tons of red earth and tossed it into the fill in less time than was required for an Indian to load a wheelbarrow. Promptly at two-o'clock lunch hour, work ceased. Little fires were lighted. The Indian worker made a frugal meal of toasted *tortillas* (paper-thin corncakes), coffee, and frijoles (beans) heated over the campfire. After a siesta, he returned to work drilling holes for dynamite or pushing a wheelbarrow.

The new Pan American Highway is the first road in history to link the fabulously rich city of Oaxaca in southern Mexico with the capital. Today the leisurely traveler along the Inter-American route may linger beneath the cooling shade of the ahuehuete in the plaza or wander through the streets of this colonial town and observe on every hand examples of exotic Zapotecan Indian culture through the faint veneer of customs brought from Spain four centuries ago. The persistent Indian assembles for a weekly market a block from the central plaza, on the spot used before the coming of the Spaniards. For 75 centavos the Indian traveler continues to find a night's lodging and food for himself and animal in a *burro posada* (donkey inn) in the heart of the city.

Oaxaca is surrounded by ruins revealing the splendor of ancient Indian civilizations. Within walking distance of the central plaza are the recently unearthed tombs on Monte Alban. The priceless jewels of the aborigine — necklaces of solid gold, combinations of gold, jade, pearls, and onyx, and other ornaments — together with a lapis lazuli inlaid skull of a Zapotecan potentate, may be seen in the Oaxaca Museum. And only 27 miles farther south along the new highway is the ancient ruined city of Mitla, containing the early Zapotecan tombs set among wild fig, flowering pomegranate, and fragrant lemon trees. From this historic spot the road will follow the ancient caravan route to Tehuantepec. Impassable during the rainy season, when even a horse sinks belly deep in mud, it is the only broken link in the Mexican section of the highway.

On the isthmus of Tehuantepec, the narrow land bridge which connects North and Central America, lives a race no passer-by will forget. Stately, beautiful Indian women, their glossy black hair braided with many hued woolen yarns and coiled about the head like a crown, full pleated ruffled skirts swishing about slim bare ankles, Amazons all, they run the affairs of the villages and boss the local markets. During *fiestas* these beauties do not consider themselves properly attired without a full complement of long gold filigreed earrings and necklaces of solid gold ornamented with pendant $20 gold coins. On the opposite shore of the isthmus dwell their less glamorous but more startlingly clad sisters, whose costume consists of a long full pleated skirt and *nada más* (nothing more).

Perhaps the most interesting race to the traveler concerned with the infinite capacity of man battling nature for survival will be encountered about halfway down through Mexico, in the Mezquital Valley. They are the Otomi, a people who live in a land without water. The paved highway extending south from Laredo, opened in 1936, passes within a kilometer of Ixmiquilpán, market center of the Indians living in this hinterland covered with cacti and mesquite, where the thirsty soil receives rain but twice or thrice a year. This tribe of men — squat of figure, strong of limb, their straight, tar-black hair contrasting with their traditional snowy-white cotton garments — are believed to have been masters of the central plateau of Mexico long before recorded history.

The Otomi lived in caves until the Seventh Century of the Christian era, when they emerged and built towns. Always poor and reckoned a backward tribe, the homely Otomi passed as dull boors among their neighbor countrymen, the handsome and powerful Aztecs. Modern intelligence tests have proved them as bright as the average, but they continue to retain their record as the poorest of all the inhabitants of Mexico. This tribe stubbornly resist attempts to resettle them elsewhere on more productive land, or to change or improve their traditional mode of life. Enslaved by the Spaniards, the Otomi has learned by centuries of experience that any change is usually to his disadvantage. He has reason to be suspicious of overtures. One investigator has estimated that an entire family subsists on seven centavos a day. Corn, the staff of life in Mexico, grows lush in the center of the valley of the Mezquital, which is blessed with irrigation. Ten feet on the upper, or dry, side of the last water ditch, only cactus grows. The line of demarcation is sharp and final. In the arid hills the modern Otomi dwells in a makeshift hut made principally of cactus leaves.

The Otomi are taciturn, dignified. No wide-eyed savages stared in wonder when I arrived on foot and begged lodging in the settlement of El Nith. They received me as a social equal. One woman, Angelita (Little Angel), graciously offered me hospitality. Her home, made of cactus leaves, was a single, windowless room with earthen floor. Set among the cactus and mesquite in a small area on a hillside surrounded by a wall made of volcanic rock, it was typical of the dozen which composed the community. The atmosphere was smoky, the roof above black with greasy soot.

The common type of bed is a *petate* (woven mat) placed upon the earth, though some families do have raised

This typical Otomi Indian hut has a roof of maguey leaves. The trunks of growing organ cactus form its walls. Its owner, carding wool, earns his living by weaving serapes on a hand loom.

wooden sleeping platforms. The home where I stayed had one, and it was courteously given to me. Angelita, her mother, and her two young children took their *petates* and slept beneath a mesquite tree near the hut.

I shared with the family of four the simple evening meal prepared over a small campfire in a corner. This family, like its neighbors, subsists almost exclusively on a diet of corn and chili supplemented with tuna, watery fruit of the nopal cactus. Even the ubiquitous frijoles are a luxury. The local custom of eating but two meals a day springs from stark necessity. Seated in a circle about the campfire, we dined without table or cutlery. A rolled *tortilla* served as spoon.

An Otomi baby knows not the taste of orange or tomato juice, cow's milk, butter, meat, or cereal. He has never heard of spinach. Like his elders, he suffers the ravages of many preventable illnesses, such as malnutrition, malaria, amoebic dysentery, smallpox, and impetigo. Chief among his ills are stomach disorders resulting from the drinking of impure water. Entire families are also troubled with lice and fleas. Illnesses are treated with one or more of several dozen herbs, cures handed down for generations. In serious cases the witch doctor is called. A sickly child wears charms of red string or yarn about the wrist, neck, or ankle. Night air is considered dangerous. Witch doctors sell little round stones to be worn about the neck to ward off evil. These "wind stones" can be bought at the medicinal herb stall in the public market. Many of the herbs used in crude form by the Otomi, such as sarsaparilla, quinine, eucalyptus, cascara, and digitalis, have achieved a place in modern medicine.

Scarcity of water dominates life on the mesa, and a large part of Mexican labor is the carrying of water. In the dry area, an Indian will walk from two to ten kilometers to fetch a jar of water. By ordinary standards a large quantity of it is unfit for human consumption. Water shortages encourage the drinking of alcohol, more especially of pulque, an opaque drink of fermented *aguamiel* (honey water), extracted from the maguey (century plant). It is the national drink of Mexico and the only liquid to be had in Angelita's home where I visited. Even babies drink it.

I was filled with admiration for the manner in which the Otomi was able to make a go of it in a land without water where a miserly nature provides him with scarcely more than cactus and mesquite. From the several varieties of cactus he secures shelter, clothing, drink, and food. Each variety has its special use. The broad, tough, waterproof leaves of the maguey supply the principal building material for a home. The Otomi ties the framework together with fiber. Bent leaves hooked over parallel bamboo poles form a satisfactory "shingled" roof. When completed, such a house is valued at about $8.00. Leaves cut from the same maguey and pounded produce a fiber for cloth. Each leaf is worth two centavos. A common sight is to see a woman with a hank of snowy maguey fiber draped around her neck, spinning it into thread by means of a pointed stick attached and twirled in her hand as she walks to the village or sits in the market place. (In Lapland, I saw women spinning wool in exactly the same manner.) When the maguey plant is old and about to blossom, its final service to the Indian is to provide him for a period of six months with pulque. He cuts the heart out, and a sap, or *aguamiel*, forms in the hollowed-out place. If pulque is needed, a young girl carrying an earthenware jar and slender gourd wedges herself in between the stiff leaves, inserts one end of the gourd into the *aguamiel*, sucks it up into the gourd, and empties it into the jar. At home she pours the liquid into a gracefully shaped brick-red pottery jar containing a little left-over pulque, and within a few hours it ferments and is ready to drink.

The stately women of Tehuantepec, here shown in their characteristic costume, run the affairs of the town, even to bossing the local market.

Market day, the most important institution in a Mexican village, is a combination of business, pleasure, and religion. It is the choice day for the casual traveler to glimpse a cross section of Indian life. In time past, it occurred every fifth day, and all adult males were required by law to attend. It was then illegal for a man to dispose of his wares while en route. Today the custom persists. On a given day — Saturday in Ixmiquilpán — the plaza throngs with Indians selling, trading, buying. News and gossip are exchanged, social visits are made, religion is attended to. As an added fillip, a few of the men get tipsy.

The war has prevented the immediate surge of passenger traffic along the *camino real* up and down the Americas, but romance and adventure await the future traveler. He will see living cities, old before the discovery of America, lofty volcanoes capped with snow, pyramids larger and older than those of Egypt, and ancient battlefields. A branch highway leads to the world's newest and most violently active volcano — Parícutin. But of most interest will be the people themselves. The traveler will not only have the opportunity to make friends with or to be stared at by Eskimos of the Arctic, Patagonians of the antipodes, and nationals of the republics traversed by the highway in between, but he will learn to know the hundred or more diverse races, each with distinctive mode of dress, language, and customs, which compose the population of each of the republics.

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Dean of Architecture

WILLIAM W. WURSTER, the distinguished California architect who has designed many notable buildings and large-scale housing projects, has been appointed dean of the Institute's School of Architecture. Mr. Wurster succeeds Dean Walter R. MacCornack, '03, who retired on July 1.

Dean Wurster's work stresses the importance of regionalism and indigenous design, and his solutions are characterized by originality and freedom from stylistic restrictions, either modern or traditional. One of his notable designs is the United States Housing Authority slum clearance project, Valencia Gardens, in San Francisco, which he designed in association with Harry A. Thomsen, Jr. He also designed the Yerba Buena Club on Treasure Island for the Golden Gate International Exposition in San Francisco in 1939. Another example of his work is Stern Hall, a dormitory for women students at the University of California, which was designed in association with Corbett and MacMurray of New York. His Valencia Gardens project and the Schuckl and Company office building, an outstanding example of a business building for a country town, have been chosen by the Museum of Modern Art as examples of significant American buildings of the past 10 years. Carquinez Heights at Vallejo, Calif., and the Parker Homes at Sacramento are war housing projects designed by Mr. Wurster. In association with Franklin and Kump, he participated in the design of Chabot Acres at Vallejo. His professional experience includes notable work on filtration plants, one of which was developed for the East Bay Water Company in California.

Mr. Wurster was born at Stockton, Calif., on October 20, 1895, and is the son of Frederick William and Maude Evelyn Wilson Wurster. He was educated in the public schools of Stockton, after which he entered the University of California and was graduated with honors in 1919. His boyhood interest in construction was fostered by his family, and even before he had entered college he spent his vacations working in the office of an architect. During his studies at the University of California, Mr. Wurster took a course in naval architecture and marine engineering, after which he made several voyages across the Pacific and became familiar with the Hawaiian Islands and the Philippine Islands. In 1920 Mr. Wurster joined the staff of the architectural firm of John Reid, Jr., which was then engaged on the design of a group of San Francisco school buildings. This experience was followed by two years in Sacramento working under the direction of the architect Charles Dean and the well-known sanitary engineer Charles Gilman Hyde, '96. Mr. Wurster's experience during this period included drawing, specification writing, and field inspection, which required close collaboration between architects and engineers. He was licensed to practice architecture in the state of California in 1922.

After these three years of varied experience, he traveled for a year in Europe, studying architecture in France, Italy, and Spain. He returned to New York to gain further experience with the architectural firm of Delano and Aldrich. During a year in the East he carried on intensive architectural studies of the principal Atlantic Coast cities.

Sturtevant

William Wilson Wurster

Mr. Wurster went back to California in 1924 to undertake the development of the filtration plant for the East Bay Water Company. When this commission was completed in 1926, he opened his own architectural office in San Francisco. His work between 1926 and 1934 included several notable country houses and the development of the Pasatiempo Country Club near Santa Cruz. By this time his work was attracting wide attention, and he was awarded a number of prizes in the *House Beautiful* annual competitions and honorable mentions in the northern California exhibitions of the American Institute of Architects.

In 1937, Mr. Wurster went to Europe to study the modern English housing projects and the work of outstanding Scandinavian architects, including Alvar Aalto of Finland. He then went to Germany to study the Frankfurt housing projects. Upon his return from his European trip, Mr. Wurster married Catherine Bauer, who has done notable work in housing and is the author of *Modern Housing*, *A Citizen's Guide to Public Housing*, as well as many articles and pamphlets.

In 1943, after 20 years of practice which included 5,000 war houses, Mr. Wurster closed his architectural office to study war and postwar architectural problems. He has since done special research on urbanism and planning.

Harvard University invited him to carry on his research work as a fellow in the graduate school of design, and as part of this study he took a city planning course under Professor Frederick J. Adams of the Institute's School of Architecture. This work, combined with study at Harvard under John Gaus, Alvin Hansen, and Joseph Hudnut, dean of the faculty of design, completed the preliminary work necessary for his doctorate in regional planning. To broaden his experience further, Mr. Wurster served as co-ordinator of design in the architectural school at Yale University for one term.

Postwar Curriculum

CHANGES in the undergraduate curriculum of the Institute to meet the special requirements of education in science, engineering, and architecture after the war, were approved by the Faculty at its meeting on May 17. The new plan is the result of a study started last October by a Faculty committee appointed by President Compton to consider simplification of the curriculum.

The future of technical education in relation to significant advances in science during the war was considered by the committee in revising the curriculum. The new program, therefore, incorporates long-range educational policies in a flexible plan which is adaptable to the changing needs that study discerns as probable immediately following the war. Based on a two-term academic year, the new schedule is expected to meet the requirements of college men returning from war service to complete their interrupted education, as well as the needs of young men who went directly from high school into the armed services and wish to begin their college courses when they return. The most important feature of the revision is a co-ordinated four-year program in the humanities and social sciences which emphasizes the Institute's long established educational philosophy of instruction in the ethical and social implications of science and technology.

The new schedule provides for a standard curriculum for all first-year students. The second-year curriculum has been divided into two main subdivisions, science and engineering, with an opportunity for the student to begin elementary subjects in his chosen profession. The number of undergraduate subjects is reduced from 523 to 412 by the consolidation of subjects of nearly the same content and purpose, and the elimination of certain options. The variety of schedules offered in the upper years is also reduced. Under the new plan, Meteorology is established as a separate undergraduate Course leading to the degree of bachelor of science in meteorology.

The four-year program in the humanities and social sciences provides that in addition to customary courses in modern languages, students will take one full course of a nonprofessional character every year. The work of the first year will be devoted to English, with emphasis on written and oral expression. Special provisions are made for students who when they enter are ready for advanced work in English and for foreign students who require intensive instruction.

In the second year all students will be given an introductory course in modern history with special reference to the place of the United States in world affairs. On the basis of the preceding courses, especially history in the second year, the third year will be devoted to the social sciences generally, economics, and psychology. In the second half of the third year, students will be permitted to choose from a limited number of options in the general field of the social sciences. In their senior year, students will be given an opportunity to choose one of four options, namely, the history of thought, music and the fine arts, Western World literature, or international relations. Each of these four courses will be closely coordinated with the objectives and purposes of those given in the preceding three years. All classes will be held in small sections, and constant emphasis will be given to improvement in both written and oral expression.

In its social outlook the four-year plan in the humanities is an expansion of courses that have long been part of the Institute's curriculum. Even as early as 1865 when the Institute opened its doors, President William Barton Rogers was a pioneer in his conviction that a sound scientific or technical education could not be complete without adequate time and attention to the humanities and the social sciences. This purpose has been constantly emphasized.

In recent years many students have taken elective courses in pure and applied psychology, philosophy, and international relations. Most of these courses have been given on the free elective system. Thus, in the typical prewar year of 1939–1940, nearly 2,000 students were enrolled in 57 different subjects of a general and essentially nonvocational character offered for the purpose of giving them an opportunity to broaden their education by an introduction to fields of thought and interest outside their chosen professional work.

The Faculty committee which made the study resulting in the revision of the curriculum was composed of Earl B. Millard, chairman, Leicester F. Hamilton,'14, Joseph C. MacKinnon,'13, George W. Swett,'03, Arthur L. Townsend,'13, Carlton E. Tucker, '18, and Bertram E. Warren,'24.

Regular and Special

REPORTS — of officers, committees, and councils — as is customary, constituted the main business of the last meeting of the Alumni Council for the present academic year (the 239th) which was held on May 22 at the Smith House in Cambridge. In addition to the regular reports which were heard and accepted, a special report, that of the committee appointed by Francis J. Chesterman,'05, President of the Association, to recommend ways and means to improve the organization and operation of the Alumni Association, came up for action, was discussed, and was passed by a unanimous vote recording the Council as accepting the report and favoring the recommendations which it made.

The special committee, under the chairmanship of the late Lawrence Allen, '07, held in their report that "the Institute during the readjustment period from war to peace conditions and in the years to come will need all the help, both financial and otherwise, that its Alumni can give; and further, that Technology men of all ages will welcome increasing co-operation and assistance from the Institute and from each other." The Alumni Association, the committee asserted, is the logical agency to provide this assistance and co-operation. "To improve our present procedure and broaden our sphere of activities," the report declared, "a man of suitable qualifications should be engaged on a full-time basis to function as an assistant to the President of the Alumni Association."

M. I. T. Photo

Robert Hallowell Richards, '68, the Institute's oldest living Alumnus, in the garden of the house in Jamaica Plain where he has lived for 70 years. Professor Richards, now in his 100th year, was born in Gardiner, Maine, on August 26, 1844. When he retired in 1914 with the rank of professor emeritus, he had been head of the Department of Mining and Metallurgy for many years and a member of the Institute staff for 46 years.

This officer, in the opinion of the committee, "should have his headquarters in Cambridge; should be an alumnus of Technology; should be of sufficient maturity and accomplishment to command the respect of all age groups who *should* be interested in the future of the Institute, including potential students of Technology, undergraduate and graduate students, Alumni and Alumnae, and leaders of industry; should be acceptable to the Institute administration and capable of rendering them service; if possible should have had an intimate association with the Institute administration and staff, so that he thoroughly understands the organization, the operation, the aims, the history, and the traditions of Technology."

"We believe," the report continued, "that the benefits accruing to Technology, to the organized alumni activities, to the individual Alumni and Alumnae, and to the undergraduate and graduate students, justify joint participation in the expense of the office by the Alumni Association and the Institute.

"Your committee unanimously and enthusiastically visualizes great benefits to Technology as a whole in the proposed plan but intentionally does not recommend in this report the specific duties of such an office, believing that such duties can best be determined gradually and in consultation with the Council, Alumni Association officers, and the Institute administration.

"We recommend adoption of the program as outlined and that steps be taken to put this program into effect."

Rowland S. Bevans, a graduate of the Carnegie Institute of Technology, now doing advanced study at the Institute, was introduced as the fourth in the season's list of speakers on student activities. Surveying life in the Graduate School, Mr. Bevans presented an interesting picture of how research goes on and how war needs have led to unforeseen research opportunities.

Henry B. Kane, '24, Director of the Alumni Fund, whose distinguished work as a photographer and interpreter of nature is well known to Review readers, was the speaker of the evening. Showing a large and representative group of pictures made in his studies of birds, beasts, and bugs, Mr. Kane combined comment and narrative in a witty and compelling fashion. His presentation was received with hearty applause.

Appointment

PROFESSOR JOHN B. WILBUR, '26, has been appointed acting head of the Department of Civil and Sanitary Engineering, succeeding Theodore B. Parker, '11, who died in April.

Professor Wilbur is a native of Oakland, Maine, and was educated at the Academy High School in Erie, Pa., and at the Institute, from which he was graduated in 1926. He was awarded the degree of master of science in 1928 and his doctorate in 1933. He served as an assistant in his Department from 1926 to 1928, when he joined the engineering staff of the Maine Central Railroad. From 1929 to 1930 he was a bridge designer and detailer for the New York Central Railroad. In 1930 Professor Wilbur returned to the Institute as an instructor in civil engineering and was promoted to the rank of assistant professor in 1934. He was named an associate professor in 1937, and was appointed professor of structural engineering in 1943.

Professor Wilbur was associated with the firm of Fay, Spofford and Thorndike on the design of the Lake Champlain Bridge, as well as the continuous truss highway bridges over the Cape Cod Canal at Bourne and Sagamore. He has also done important consulting work for various engineering and insurance companies. Since 1940 he has been chief engineer for the Smith-Putnam wind turbine project in Vermont for the S. Morgan Smith Company. Professor Wilbur was responsible for the development of the Structural Analysis Laboratory which was established at the Institute in 1936, and in 1934–1935 he developed and built the simultaneous calculator, a computing machine which solves nine linear simultaneous equations.

Professor Wilbur, an associate member of the American Society of Civil Engineers and a member of the Boston Society of Civil Engineers, has twice received the designers' section award of the latter society. In 1943 the society presented him with the Desmond Fitzgerald Award. He is also a member of the Society for the Promotion of Engineering Education and of Sigma Xi, and an honorary member of Chi Epsilon, the honorary civil engineering fraternity.

He is the author, with Professor Walter M. Fife, '21, of a textbook, *Theory of Statically Indeterminate Structures*, and of many technical papers and bulletins.

Recognition for Service

AWARD of a Certificate of Service was made to President Compton by the Army Air Forces Training Command at graduation exercises on June 5 for the more than 200 cadets of the Army Air Forces who had completed an intensive eight months' (*Continued on page 574*)

You'd be proud of our work. Paul Revere!

It is some sort of understatement to say that Paul Revere would be quite surprised if he were to walk through one of the plants that carries on the business he founded.

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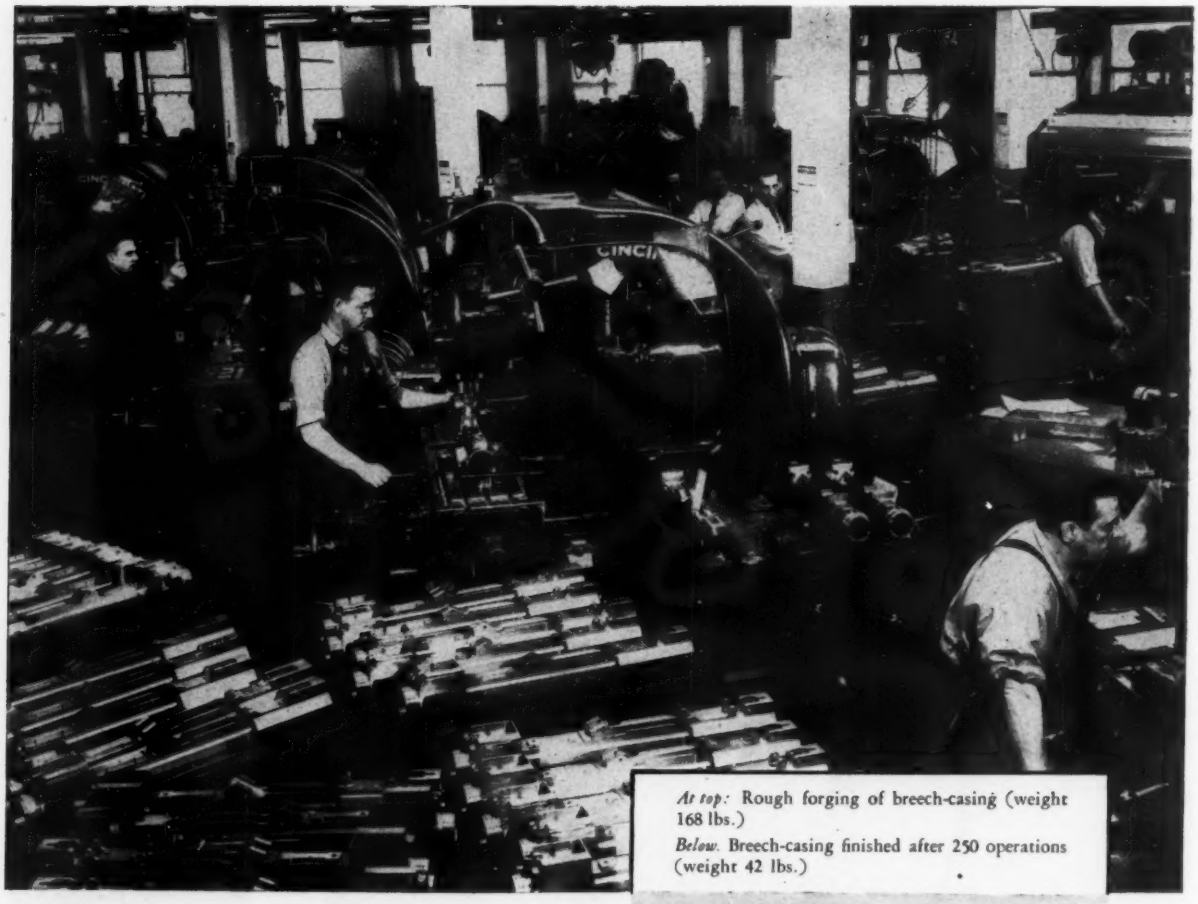

At top: Rough forging of breech-casing (weight 168 lbs.)

Below. Breech-casing finished after 250 operations (weight 42 lbs.)

How Taft-Peirce Contract Service Tackled Many Jobs in One...

to turn blue-prints into breech-casings

Late in 1940 Taft-Peirce Contract Service Engineers were asked how soon they could produce breech-casings for the now famous Oerlikon 20 mm. anti-aircraft gun. At that time the gun existed in the U. S. only on paper.

This complete breech-casing has been characterized as the toughest machining job in the whole war effort. Despite this, T-P engineers set to work to procure equipment, recruit men, design and build tools, jigs, fixtures, and gages to manufacture this "heart of the gun" which required over 250 operations on a single forging. All of this was accomplished ahead of schedule; and less than 6 months after prints were received, the first breech-casing came off the production line, followed by an endless stream of these vital parts.

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GENERAL RATTUS

(*Continued from page 545*)

For the next rodent-borne disease the best known name is Japanese river fever. What seems to be the same disease is also called tsutsugamushi, flood fever, scrub typhus, and Mossman fever. It is found along the eastern fringe of Asia from Japan and Malaya into the Dutch Indies and also in northern Australia. The causative organism, a Rickettsia, is harbored by mice and passed from one animal to another by mites, which are rather like the chiggers or red bugs of our southern states.

Obviously a serious rat problem exists. What can be done about it?

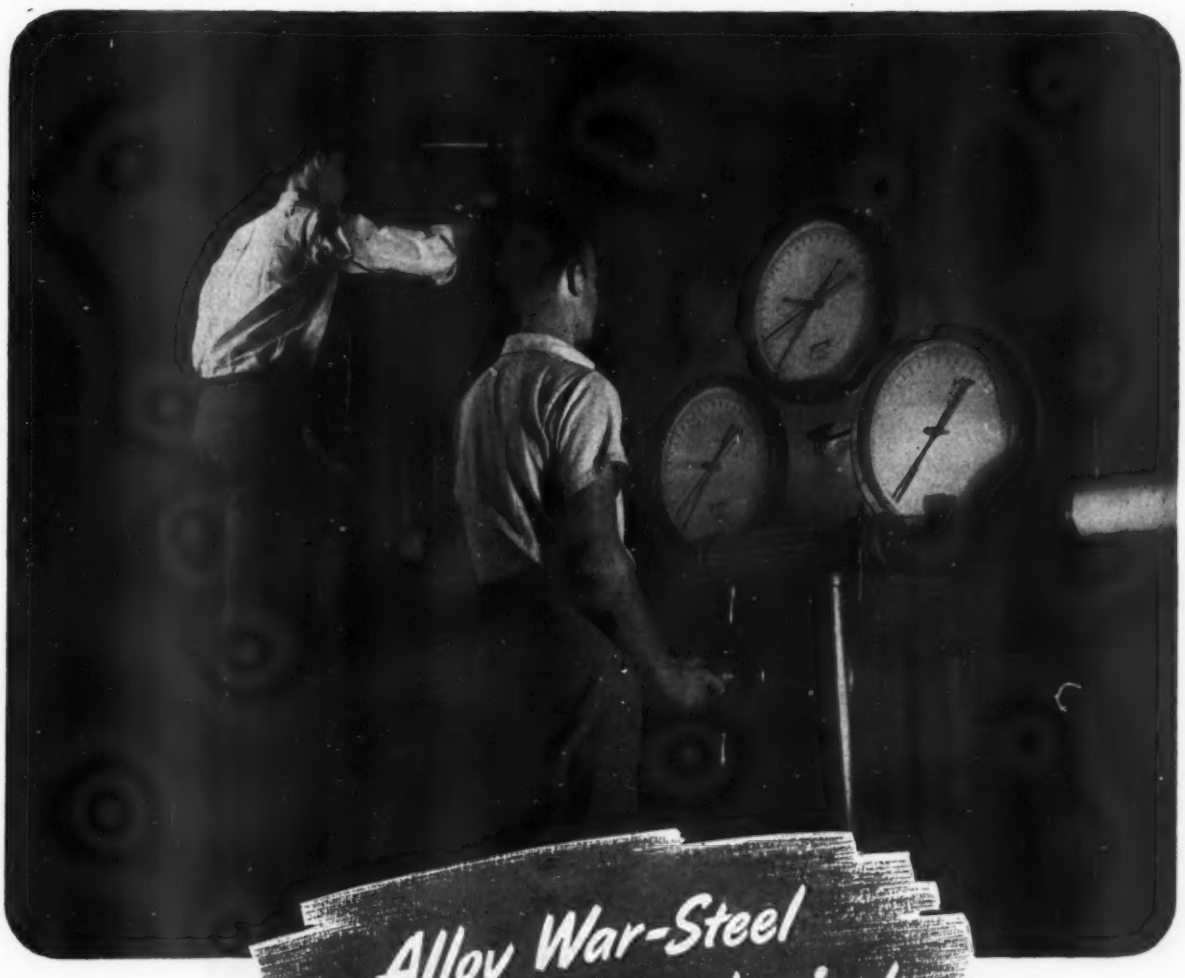
From the point of view of a biologist, the important thing is to deny food and shelter to the animals and let nature take its course. This is not a simple solution. It means essentially that buildings must be so constructed that rats cannot gain access to them and that food must be so stored that rats cannot break in. Notice that I have said nothing about killing rats; we should likely not have occasion to kill one if we did not provide them with food and shelter.

In the past, however, the emphasis on killing rats has been great. It has led in cities to the malodorous rat campaign — that is, to the theory that to keep the problem under control it is only necessary to slaughter rats intensively at intervals without undertaking other measures.

Such campaigns have not worked for two very good reasons: First, it was never possible to kill all the rats and to prevent all immigration; hence as long as rats had access to food and shelter, they were able in the periods between campaigns to rebuild their forces. Second, rat campaigns unfortunately had a political tinge which, of course, led in the first place to the doing of the easy or relatively cheap thing of killing the visible rats without making the long-range repairs which would have effected some measure of permanent control and which would have also cost individual property holders money. Of course, the killing of rats cost money too, but it was not obvious that the property holder had to put his hand in his own pocket for it. Further, a marked tendency has been for the campaign itself to be exploited by unscrupulous persons who secured more or less meaningless credentials or endorsements from city officials and then, armed with apparent official status, proceeded to make whatever profit they could from property holders, frequently giving little or nothing in return for the money received. This is no reflection on the legitimate pest-control operator who can play an important part in a genuine rat-control program. The over-all weakness of the rat campaign is obviously its failure to enlist the lively and intelligent support of the general body of citizens.

Strong effort is being made now in this country to substitute for the rat campaign the concept of the rat-control program. The setting up of such programs in cities has been vigorously fostered by the division of predator and rodent control of the United States Fish and Wildlife Service. Although the service does not itself do control work or initiate such programs, it does aid in laying out programs on request and in choosing and training competent executives to administer them. Because of this intimate connection with existing programs, the views of the service are of great interest. It feels that the city must

(*Continued on page 562*)



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OWI Photo by Palmer, in an Allegheny Ludlum Plant

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BATH, MAINE

GENERAL RATTUS

(*Continued from page 560*)

lead in putting its house in order by eliminating rats from parks, abattoirs, dumps, and other public properties, as well as by installing proper and adequate collection and disposal systems for garbage and trash. The public must be educated to the need for rat elimination from houses and food establishments. It must be made clear that the killing of rats and the ratproofing of buildings go hand in hand. Everyone must understand that rat control, like charity, begins at home. Although rats must be killed, partly to prevent their migration from ratproofed areas, the ratproofing of buildings and elimination of outdoor sources of food are even more necessary. The co-operation of various agencies in the city should be obtained through organization of a central committee headed by one man. This committee should include a member representing local pest-control operators, who should have a definite part in the campaign.

One of the earliest large-scale campaigns was carried out in the city of Cleveland. The following is a brief outline of the plan laid out there:

A. Publicity work by all supporting groups to arouse interest in and demand for services by stressing the reasons for the urgent need.

B. Public education by the supervisor of rat control to supply practical information to building owners and managers, their maintenance employees, feed handlers, and the public at large.

C. Action by the rat-control specialists to obtain a detailed and accurate knowledge of the degree of infestation; to inspect

(*Concluded on page 564*)

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KEEPING UP WITH *Electricity*

ORDNANCE SPELLS IT F-U-Z-E, when referring to the mechanical device that keeps bombs safe to handle, but sets them to detonate on impact. If bombs are to be both safe and effective, fuze-timing must be accurate to a split second. To test them, Westinghouse engineers designed a new miniature wind tunnel, in which a blast of compressed air simulates speeds up to 800 miles an hour. A photoelectric cell device checks the timing to one one-hundred-twentieth of a second.

NEW FLUORESCENT DEVELOPMENTS include a *cold cathode* tube that lights up instantly; a new type of starter that eliminates blinking of fluorescent lamps; and a bulb so tiny that it can operate for several weeks on power from a single dry cell.

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NEW HURRICANE is now in service with Boeing Aircraft Company. Westinghouse has just installed an 18,000 horsepower electric motor to drive the multi-bladed fan in Boeing's new wind tunnel. One of the largest operated by a private aircraft manufacturer, the new tunnel will be able to test airfoils, etc., at speeds up to 700 miles an hour.

When .0001 inch = 1000 hours

Problem: To provide an air-tight joint where the insulated connectors of an airplane radio vibrator project through the metal shell. (Vibrator contacts disintegrated in *ten hours* at high altitudes, when shells were not air-tight.)

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GENERAL RATTUS

(*Concluded from page 562*)

premises and serve orders to ratproof, eliminate rats, and clean up; to provide free ratproofing advice and supervision; and to obtain needed rat-control ordinances.

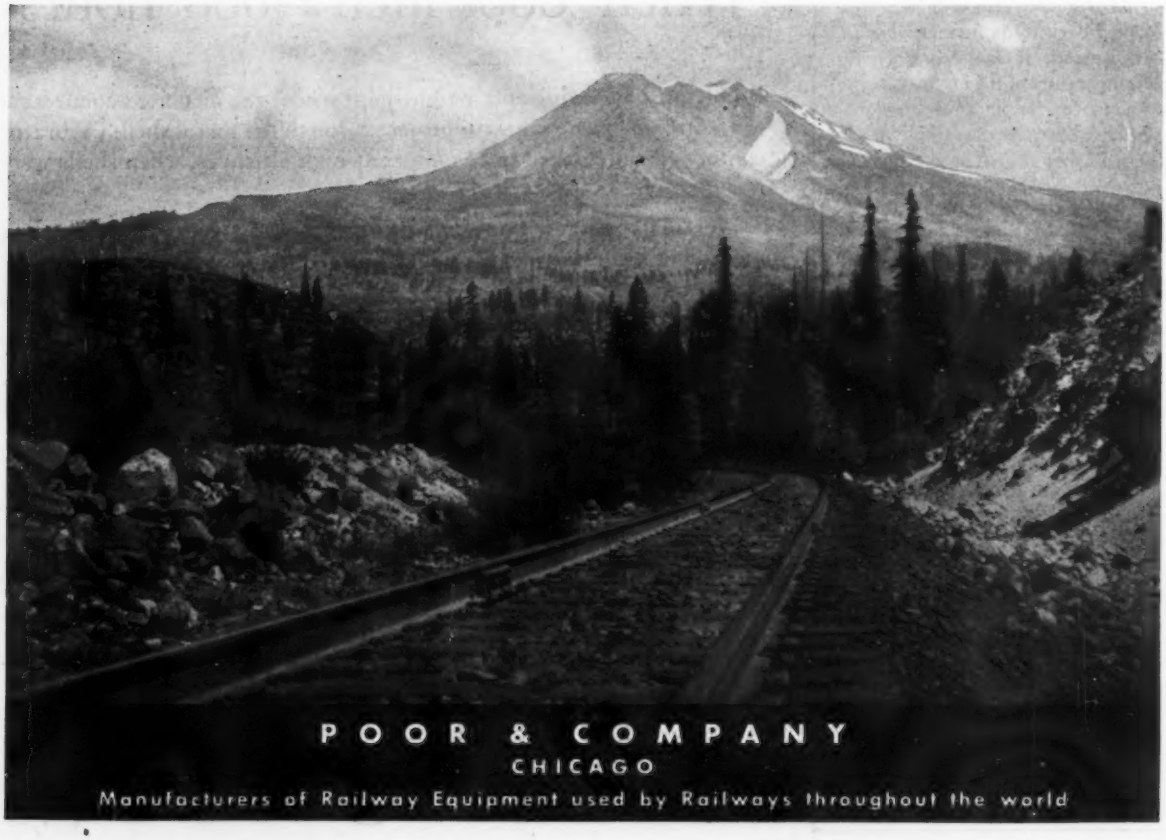
D. Action by the citizens' committee on rat control to study various problems concerning the initiation of municipal rat-control measures, to advise the supervisor of rat control on publicity, education, and adoption of ordinances, and to obtain action by other communities in the area.

E. Co-operative action by the municipal government, when called upon by the supervisor of rat control, to aid in the application of the cardinal items of permanent control. These include sanitary, food, and drug inspections, garbage collection and dump management, demolition of dilapidated structures, adoption of building-code laws, fire-prevention inspection and the sale to the public at cost of certain ratproofing equipment possibly.

St. Louis is in the middle of a very successful program. It is essentially of the same nature as the one in Cleveland but has aroused rather more general public activity. After the initial educational phases, the division of the city which had been made by the Office of Civilian Defense was utilized so that each district had its chief, each zone its deputy, and each post its worker. This resulted in the obtaining of some 17,000 volunteer workers who were instructed in the measures to be taken and who in their turn instructed the various householders. It is noteworthy that the order of events in the program was (1) education, (2) elimination of food and harborages and the ratproofing of buildings, and (3) extermination. The actual extermination has been done in part by groups of men borrowed from the city departments and in part by some 750 volunteers who have been specifically trained in that work. The Secretary of the St. Louis program believes that the civic pride awakened by the smoke elimination program of 1940–1941 was in a large part responsible for the success of the rat program, and we may draw the conclusion that such a program anywhere must depend upon the wholehearted co-operation of the majority of citizens. The motive power must come from the rank and file and not be imposed from above.

No figures for the actual number of rats killed are available, since most of the dead rats are never actually seen. It is just as well that this is so. In the past, too much emphasis has been placed on the number of rattails brought in, and, as we have already said, this obscures the long-range aspects of rat control and also aids in transmitting diseases to people. Cutting rattails is a mere evidence of successful minor tactics but gives no picture of the success of the planning and strategy which are as necessary in warfare on rats as in warfare between nations. Cutting off tails is no way of regaining control of your city from General Rattus.

How long are we going to put up with these unbidden guests? In rat control as in public health, we can have what we want and are willing to pay for. But we must really want rat control; no one will hand it to us on a platter. This is something to do now, not in some vague postwar era. Is John Citizen going to be vanquished by a mere rodent? Is he a man or a mouse?



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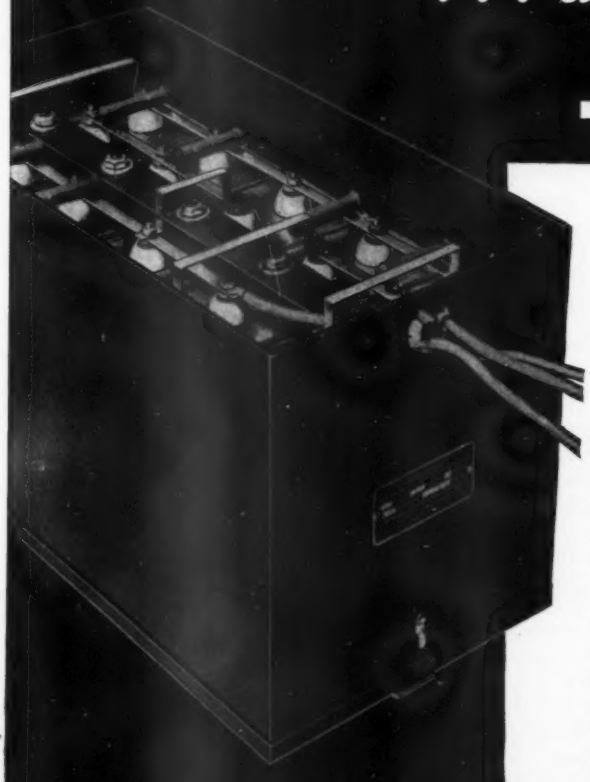

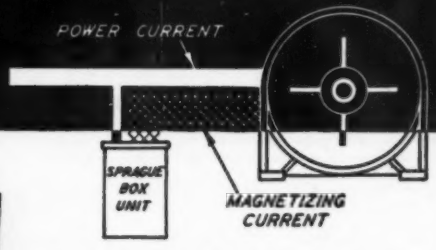

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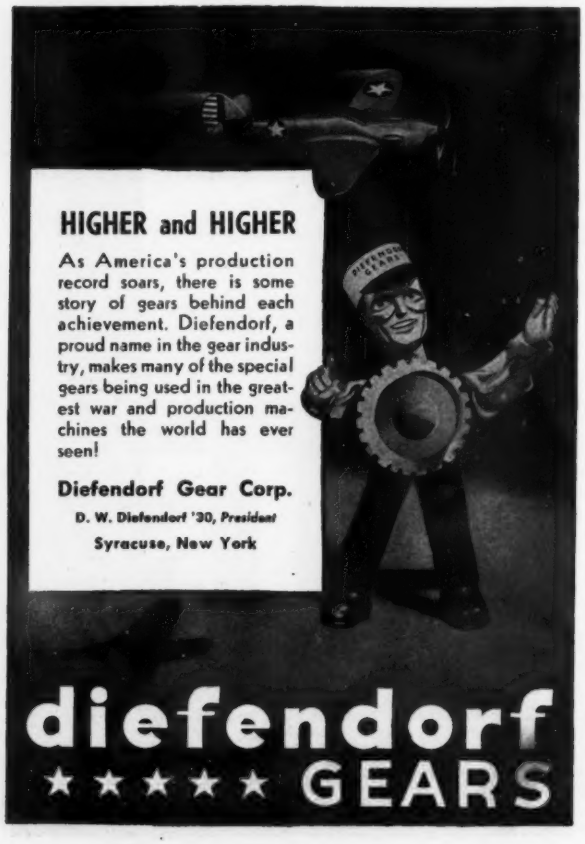
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THE OIL SITUATION

(*Continued from page 548*)

Perennially expressed is the hope that some revolutionary method of oil finding may bring a solution to these many problems. It is doubtful whether any such development is forthcoming. All the physical and chemical properties of oil and its associated rocks have been under careful scrutiny by specialists for some time, and to date very little new knowledge has been brought to the assistance of exploration geologists. The greatest promise ahead seems to lie in the thorough application of proved methods which to date have been responsible for the discovery of nearly one-half of the nation's petroleum. Through extension and refinement of these methods, we hope to discover the remaining half of the estimated reserves.

The annual meeting of the American Association of Petroleum Geologists recently held at Dallas, Texas, provides the keynote for exploration in the immediate future. This association, with a membership of over 4,000, represents the greatest array of scientific oil-finding talent in the world. A brief report of the recent meeting outlines the probable trends for the coming year in exploration for oil.

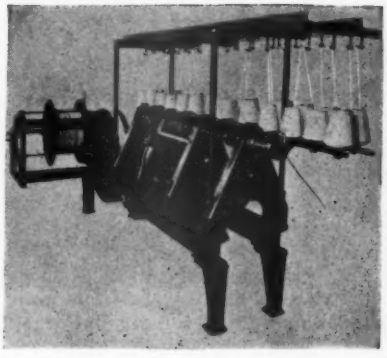
Oil finding is fundamentally a problem in geology. There are a few persons, impressed by the extent to which instrumentation has been developed, who think that the search should be turned over to others. Geophysics and geochemistry are the terms under which nongeologists press their arguments. The real distinction is the approach and manner of thinking about the problem. Nongeologists sometimes try to reduce it to formulas and equations. By so doing, they inevitably restrict their thinking and consequently lose sight of important parts of the problem.

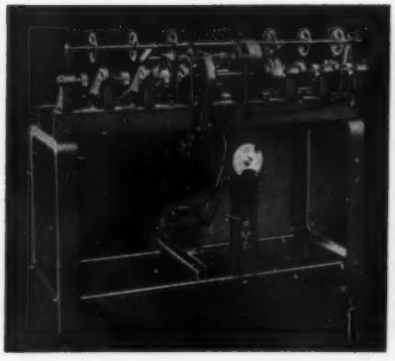
The methods of the scientific oil prospector are something like those of the diagnostic physician. At least six essential conditions must be met at one spot if oil is to be found. The geologist cannot know all these conditions directly. He must infer the probability of their presence from such data as are available to him. If all six conditions seem to be satisfied, then he is willing to recommend to his production department that a hole be drilled in the most favorable spot.

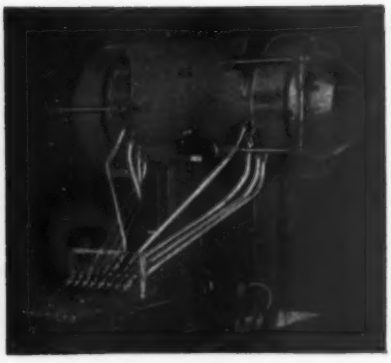
For the past 15 years most scientifically located oil wells have had as one essential condition the location of a structural trap. This is most simply defined as a place where the attitude of sedimentary beds prevents the movement of the trapped oil to other places. Simple anticlinal folds, domes, and ridges, or combinations of these with faults and gradations in permeability account for most of the structural traps located by direct attack. In these surveys the reflection seismograph gives the most direct and most accurate results.

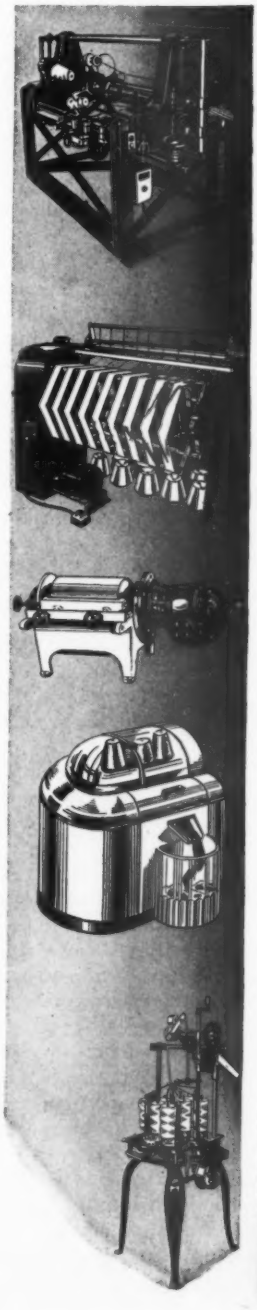
The seismograph employs the sonic echo as its fundamental working principle. A small charge of dynamite exploded in a shallow hole at the surface of the ground is the source of sound. Part of the waves travel vertically into the earth; if they encounter one or more acoustic discontinuities, an echo occurs at each of these horizons. The reflected wave is received at the surface by electromagnetic detectors, amplified, and recorded on a moving photographic film. A number of these records are taken at

(*Continued on page 568*)









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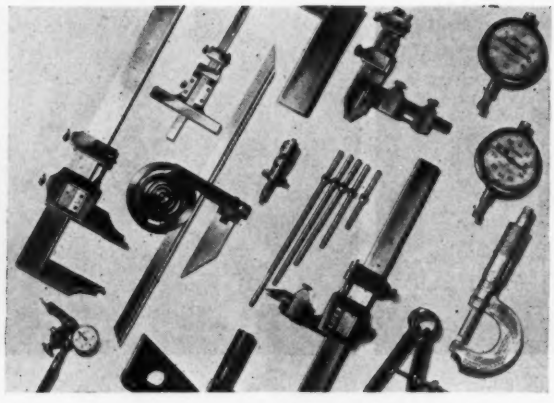

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THE OIL SITUATION

(*Continued from page 566*)

a single shot point, embracing the sedimentary column from 2,000 to 20,000 feet. By calibration of the velocity of the waves at wells in the area, the exact depth to various reflecting horizons can be computed. This method gives a map which represents the paleogeography of ancient times. On it will appear structural features pertinent to the accumulation of oil. Even though the geologic section may be traversed by one or more great unconformities, the attitude of key horizons can be mapped with satisfactory accuracy, usually plus or minus 25 feet.

Indirect methods of approach to structure measure the distribution of the earth's gravitational and magnetic fields. They assume that anomalies result from the distribution of the mass of basement rocks. The depth of the anomalies cannot ordinarily be computed accurately. If features so discovered are of large size, the disturbances may be caused by variations in the composition of the disturbing rocks rather than by the distribution of their mass. Such anomalies have no bearing on accumulations of petroleum.

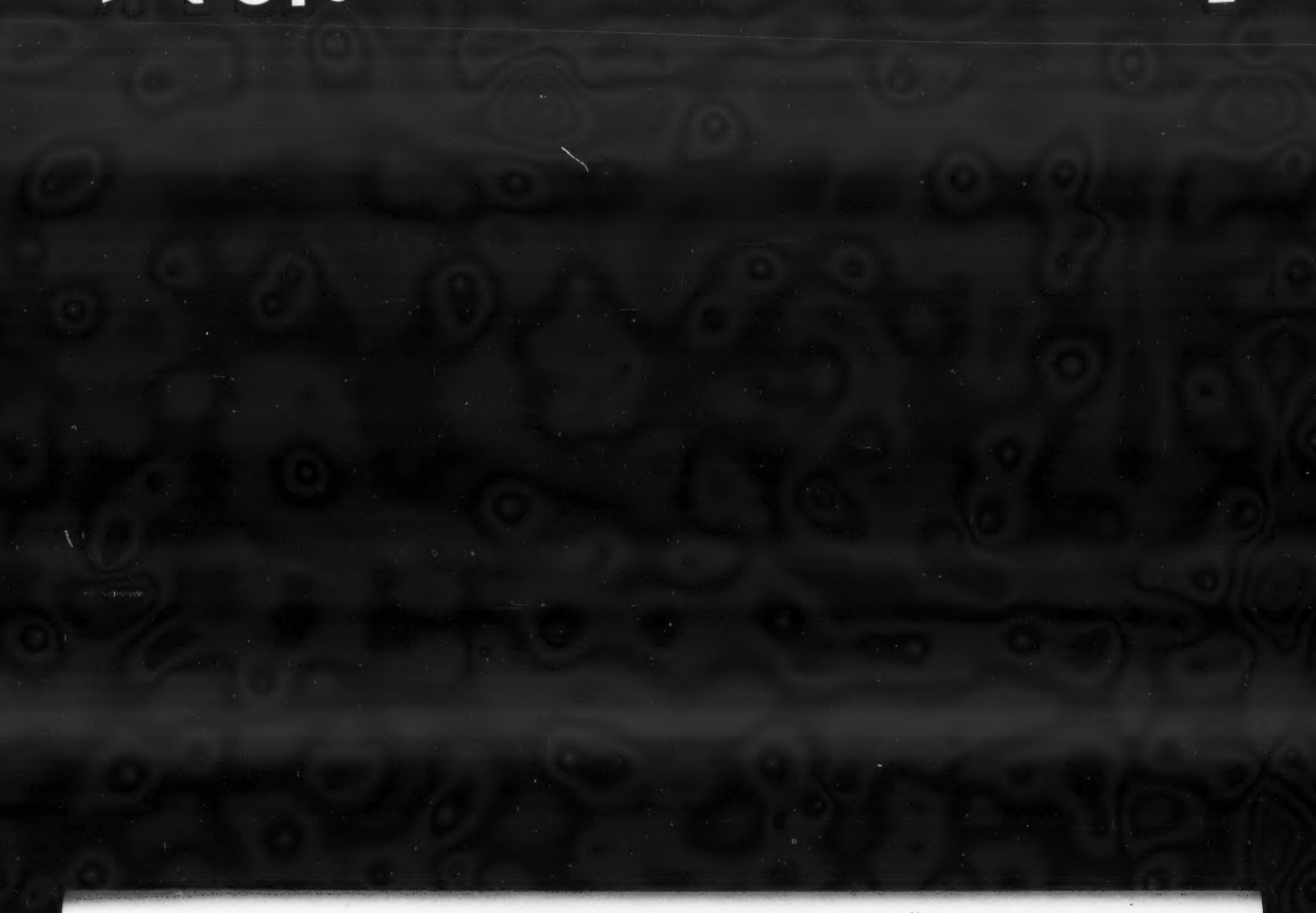
Measurements of the electrical resistivity of rocks in place and of the potential distribution of an induced electromagnetic field are of use in determining subsurface structure provided no shallow sheets of conducting fluids or rocks are present. To depths of the order of 3,500 feet, electrical methods have been of great use, particularly in reconnaissance surveys. Recent developments in electrical methods may promote further application of them.

At present nearly 400 geophysical parties are at work in the United States. Of these, 270 are reflection seismograph parties, 95 are gravity parties, and the rest are magnetic, electrical, and miscellaneous. This exploration represents an annual expenditure of about $35,000,000. The total annual exploration cost of $350,000,000 includes all other costs incidental to finding oil, such as drilling, permits, and lease expenditures. Many exploratory wells have been located without the benefit of scientific study. Others have had geologic advice. Most of the discoveries have had the benefit of all available scientific data.

Geologists and others charged with the responsibility of finding the nation's oil are thinking in three dimensions: lateral and vertical extension of their geologic provinces. Authorities generally agree that one-half the nation's oil supply has been found. Most of it has come from rich deposits. The bulk of the remainder will probably come from less prolific fields. The areas containing these fields have not been thoroughly examined simply because it has not been profitable to do so. Now that it is necessary, there seems no reason to doubt that the task will be effectively done.

For every new geographical area brought into production, at least one new oil province may be buried beneath it. Deeper drilling in 1943 accounted for over 10 per cent of the year's new discoveries. We do not know what may lie beneath many of the nation's richest pools until they are pierced with deeper wells. The advantage of this area of exploration is that production and distribution facilities are already in place, and the added cost of deeper drilling is to a great extent offset by their presence. In many pools

(*Continued on page 570*)



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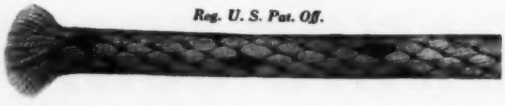

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THE OIL SITUATION

(*Continued from page 568*)

the deeper oil is not directly beneath the shallow production. In these cases the delineation of structure by the reflection seismograph may prevent the drilling of many dry holes. The correlation of seismic and subsurface data in this manner represents the ultimate in the resolution of this precise instrument. By corrections for deviation of the deep hole from the vertical, and for changes in velocity of travel, the precision of the measurements can be greatly improved.

Structural control of accumulation is receiving less attention in developed areas as its use nears the point of diminishing returns. We read widely today of "stratigraphic traps" and "sedimentation traps." Actually it is difficult to ascribe the control of accumulation to one single factor, and in many strongly held arguments of sedimentation as a major agency it is possible to show that the attitude of reservoir rocks cannot be neglected. However, studies in sedimentation are increasing in their occurrence and importance. Some prophesy that most of the new oil will be found from these studies. It is odd that the teachings of eminent sedimentationists have been so long neglected.

Strange as it may seem, geologists have no uniform theory of the origin of oil. Upon a few points the majority of them agree: These include the fact of oil's marine origin from microscopic organic matter. The agency or agencies by which this matter is transformed into petroleum hydrocarbons are at present unknown. Prominent hypotheses include the action of anaerobic bacteria, other biological processes, thermal-pressure effects, and alpha particle bombardment of organic matter. One of the most troublesome points is the exact nature of petroleum. Only a small fraction of its many constituents are known. The United States Bureau of Mines is making progress on this aspect of the problem, but another generation may be required to correlate this knowledge with geologic factors now under study. Little is known as to the chemical composition of the original organic endowment. The fact is well established that marine sediments of the type known as "source beds" contain sufficient organic matter to supply observed accumulations of petroleum. Even here arises a question as to the exact formation from which the oil may have come.

To solve this fundamental question the American Petroleum Institute since 1941 has sponsored its research project 43. It is being conducted jointly by Pennsylvania State College, the Scripps Institution of Oceanography, and the M.I.T. Frequent meetings are held by the three groups, together with an advisory committee of oil company geologists who receive and comment upon the reports. Under these auspices it is hoped that the origins of oil may ultimately be brought to light.

Regional studies, based upon examination of well cuttings, lead to broader concepts of petroleum accumulation than those which consider it to be controlled by local structure. Within a petroliferous province there must have been a preliminary concentration for the ultimate petroleum content to be found in the much smaller area now occupied by an oil field. Organic matter and the transformed petroleum are not abundant enough in most recent sediments to account for commercial oil deposits;

(*Concluded on page 572*)

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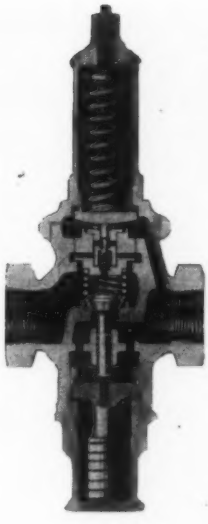

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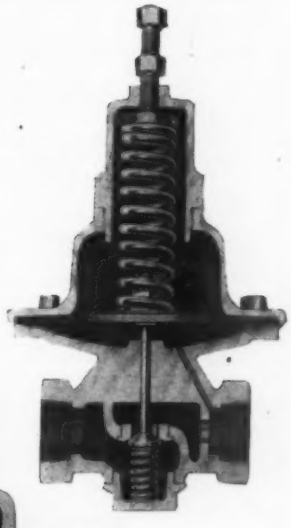

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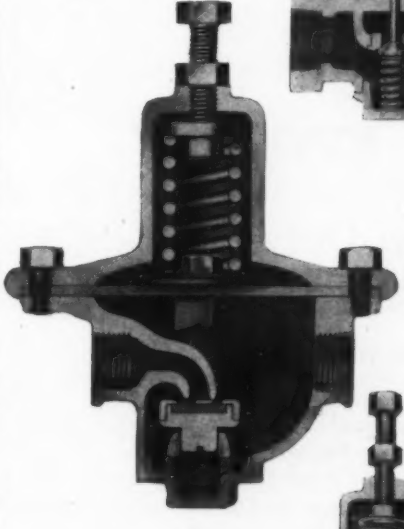

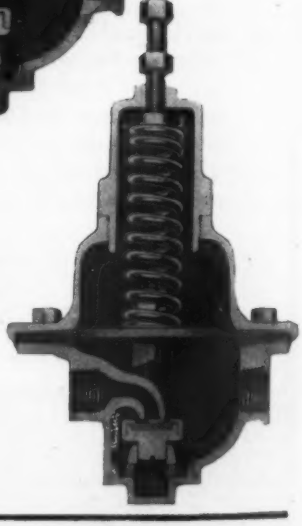

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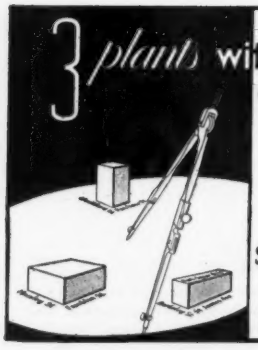
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THE OIL SITUATION

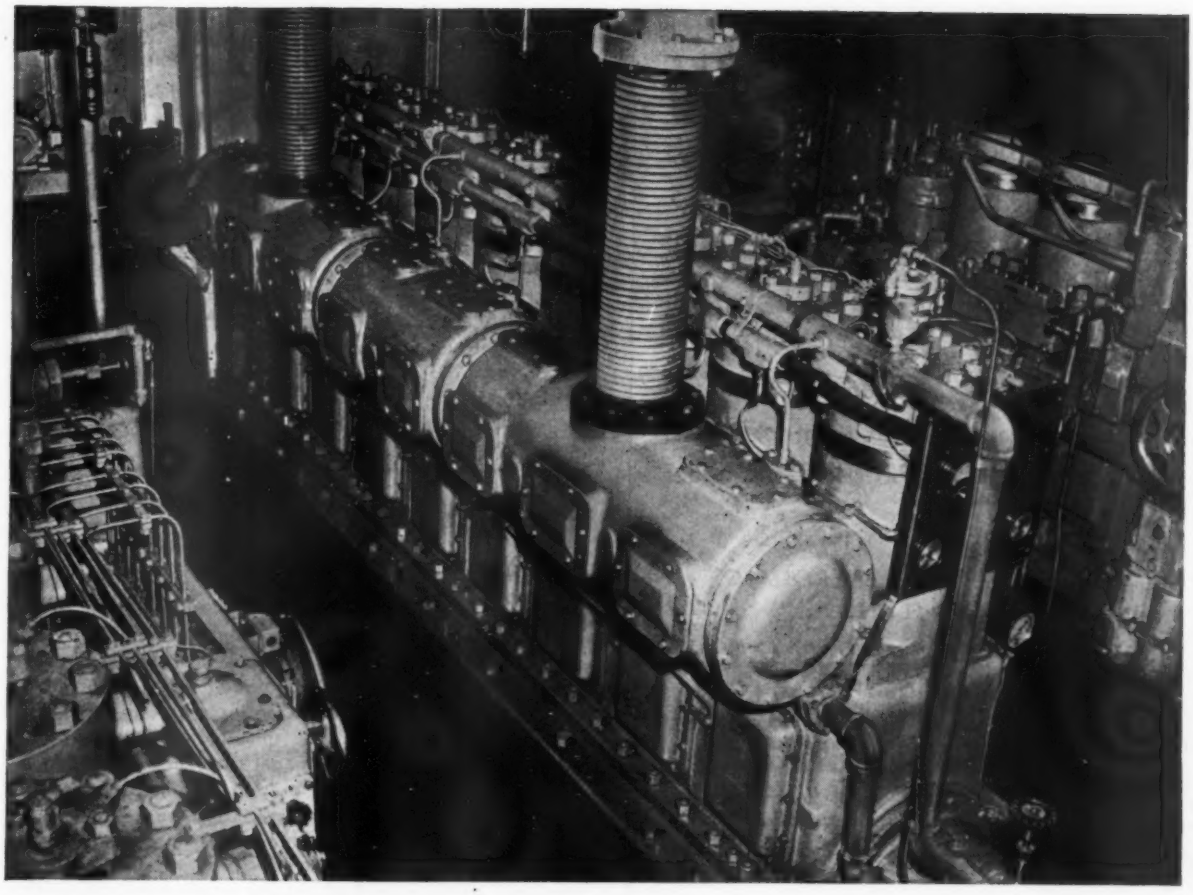
(*Concluded from page 570*)

hence there has arisen the idea of migration within source beds and reservoir rocks to the ultimate place where oil is found. An important factor in these concepts is the time available for the transformation of indigenous organic matter into petroleum. It seems unreasonable to suppose that liquid hydrocarbons could have moved in the required quantities through impervious shales which compose at least part of the source beds. During their burial and compaction, the permeability of shales to oil and gas is high, permitting source material and transforming agencies to migrate into more porous formations. After burial, shales are greatly compacted, losing their porosity and permeability.

Since the fraction of time during which these ingredients for the formation of oil have reposed in source beds is a small fraction of all subsequent geologic time, we have two alternatives to any theory of the origin of oil. The transforming agencies have either completed their work in the time spent in the source bed or have migrated along with the protopetroleum to the reservoir rock where they have continued to act throughout the ensuing geologic time. Much controversy has arisen over the question whether migration is lateral (parallel to bedding planes) or vertical (across bedding planes). Of significance is the fact that lateral permeability of shales is greater than vertical after compaction. Sands compact relatively little, and unless they contain substantial quantities of shale or limestone, their differential permeability is not great.

The organization of these ideas on the origin of oil, its migration, and its accumulation constitute the second type of geologic thinking which is attacking the problem of the nation's declining reserves. The results of these studies will not be immediately available. In the meantime the frantic search for oil goes on with intensive application of the same old tools. Structural control dominates the prospector today. His most useful instrument still remains the reflection seismograph. Coupled with exploratory drilling, it will find most of the scientifically located oil of the next year or two. After that perhaps the long-range ideas will crystallize.

A serious handicap to all forms of exploration is the great shortage of man power and critical equipment. More than one-third of the technical specialists in this field have left for the armed services. Others have gone into special research for combat methods and instruments. The remaining few thousand are working under increasing difficulties. Their efforts are possible only with the support of a much greater number of semiskilled workers. The labor turnover on some seismograph crews has been as high as 600 per cent. New help is inefficient; the handling of dynamite by green men is dangerous. Automotive equipment is hard to get and difficult to repair. Parts are scarce; the field men often have to overhaul and repair their own trucks. To these difficulties are added the increased cost of living expenses, the freezing of wages, and the attraction of war industries with their higher pay. Only the courage of a group of pioneers holds the industry together. Those who have stuck to their jobs deserve recognition for their faithful devotion to a patriotic duty.



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THE TEACHER'S TASK

(*Concluded from page 550*)

est material advancement in standards of living and the marvelous progress in the arts and sciences of the past century have been in countries which were *free* — where democracy was believed in and practiced. This is not to say that there is no room for improvement in our social standards and our economic practices. There is plenty, but the progress should be evolutionary. Through such discussions as we are initiating at this conference, we hope to build understanding of each other's problems and points of view and to promote co-operation between our educational and our industrial activities, looking toward the building of a greater United States of America where truth, justice, prosperity, and happiness will ever increasingly prevail.

THE INSTITUTE GAZETTE

(*Continued from page 556*)

course in meteorology. The award was made "in recognition of the meritorious service rendered the Army Air Forces Training Command during World War II," by the Institute's special program in meteorology. The certificate was presented to Dr. Compton by Major Joseph F. Ratliff, Sr., commanding officer of the base unit of the Army Air Forces at the Institute, on behalf of Lieutenant General Barton K. Yount, commanding general of the Army Air Forces Training Command.

Henry G. Houghton, Jr., '27, Associate Professor of Meteorology and executive officer of the Department, presided, and in a brief address he recalled that this is the fifth group of Air Forces meteorologists to be graduated from the Institute, the first having begun its work before the Pearl Harbor attack. Lieutenant Colonel John H. Heflin, representing the Army Air Forces Eastern Technical Training Command, impressed upon the young officers their great responsibility as meteorologists.

In paying tribute to the work of meteorologists in the war, President Compton stressed the importance of accurate weather forecasting in the operations of our Air Forces in active service in the war theaters. Major Ratliff presented the aviation cadets for commission and administered the oath of office. Lieutenant Colonel H. T. Harrison, who represented the headquarters of the weather wing of the Army Air Forces, made the presentation of the commissions. The exercises were held in Walker Memorial.

Lowell Institute School

GEORGE E. RUSSELL, '00, Professor of Hydraulics, emeritus, made the commencement address at the fortieth graduation exercises of the Lowell Institute School in Huntington Hall at M.I.T. on May 24. President Compton was represented at the exercises by John W. M. Bunker, Dean of the Graduate School, who gave the graduates the official greeting of Technology, under the auspices of which the Lowell Institute School is conducted. Diplomas and certificates were presented by Ralph Lowell, sole trustee of the Lowell Institute School.

(*Continued on page 576*)

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THE INSTITUTE GAZETTE

(Continued from page 574)

Because of ill-health, Professor Charles F. Park, '92, director of the school since its establishment in 1903, was absent from the graduation exercises for the first time in 41 years. Professor Arthur L. Townsend, '13, recently appointed acting director of the school, presided.

Frederic H. Fay, 1872–1944

PRESIDENT of the Alumni Association in 1913 and long active in alumni and Institute affairs, Frederic H. Fay, '93, of Dorchester died on June 5. His had been a distinguished career in civil engineering, which began with a post as draftsman for the Boston Bridge Works in 1894 after he had received the master's degree from the Institute. At the time of his death, Mr. Fay was senior partner of the engineering firm of Fay, Spofford and Thorndike, which he had formed in 1914 with Professor Charles M. Spofford, '93, and Sturgis H. Thorndike, '94. He had resigned as engineer for the city of Boston, in charge of the bridge and ferry division of the Public Works Department, to engage in private practice with the formation of this firm. Mr. Fay served as consulting engineer for many Federal and local projects, notable among them being the $25,000,000 Army supply base at South Boston in World War I and the Army base at Newfoundland in World War II. Joining the Boston Planning Board in 1918, he served on it for 20 years and also was vice-chairman of the Metropolitan Planning Division, a member of the Massachusetts State Planning Board, and a member of the New England Regional Planning Commission.

Mr. Fay, who was born in Marlboro, Mass., on July 5, 1872, was vice-president of the Alumni Association in 1902, having been a member of the executive committee from 1898 to 1900. President of the Association in 1913, he was a term member of the Institute Corporation from 1914 to 1919 and had been secretary-treasurer of his Class for 51 years. He was a former president of the American Institute of Consulting Engineers and of the Boston Society of Civil Engineers, a director of the American Society of Civil Engineers, and a trustee of Northeastern University and of the Dorchester Savings Bank. Mrs. Fay and their five daughters survive him.

To the Corporation

GEORGE A. SLOAN, President of the Nutrition Foundation of New York, was elected to special term membership on the Corporation for five years at the meeting of the Institute's administrative body on June 5.

Mr. Sloan was graduated from Vanderbilt University in 1915 and was admitted to the Tennessee bar in the same year. From 1919 to 1922 he was assistant to the chairman of the American Red Cross, and from 1922 to 1926 secretary of the Copper and Brass Research Association. He was secretary of the Cotton-Textile Institute from 1926 to 1929, when he was elected president, serving until 1935.

(Concluded on page 578)

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THE INSTITUTE GAZETTE

(*Concluded from page 576*)

Since June, 1940, Mr. Sloan has been commissioner of commerce of the city of New York and chairman of the Mayor's Business Committee. He is also a director of the United States Steel Corporation, the Goodyear Tire and Rubber Company, the Bankers Trust Company, and the Selby Shoe Company, and is president of the Metropolitan Opera Association of New York. He was a member of President Hoover's Committee on Unemployment Relief in 1931–1932 and of the Industrial Advisory Board in 1933–1934. A member of the American committee of the International Chamber of Commerce, he is also chairman of the Consumers' Goods Industries Committee and a member of the business advisory council for the Department of Commerce, Washington.

Mr. Sloan served as a lieutenant and later as a captain in the American Expeditionary Forces in World War I. He later held the rank of major of infantry in the Officers' Reserve Corps and was a colonel on the governor's staff of the Tennessee National Guard. In 1940 he received the annual award of the National Committee for Music Appreciation. He is a director of Christodora House, New York; vice-president and trustee of the Institute for the Crippled and Disabled; and a trustee of the Community Service Society of New York. Mr. Sloan is also a member of the board of trustees of Vanderbilt University.

Jubilation

TECH Night at the Pops, which for the duration is being sponsored by the Alumni Association, took place this year on Saturday evening, June 3, with Symphony Hall sold out. It was a gala evening, and marked by extra jubilation resulting from the fact that in the afternoon Technology crews had made a clean sweep of the Charles in a three-race regatta with Harvard. Recollections of this event gave added point to the singing of the new song, "Sons of M.I.T.," by members of the Glee Club under the direction of George Sawyer Dunham, conductor, at the midpoint of the Pops program. Times in the races were slow, for all were rowed in rough water and against a head wind. In the first race, for 150-pound crews, these were the results: M.I.T. first crew, 8:18.3; M.I.T. second crew, 8:31; Harvard varsity, 8:49. Two Technology crews finished ahead of the Harvard jayvees thus: M.I.T. junior varsity, 8:17.4; M.I.T. third crew, 8:23; Harvard junior varsity, 8:44. In the Henley, closest race of the afternoon, the M.I.T. crew rowed in 8:23, with Harvard less than a second behind.

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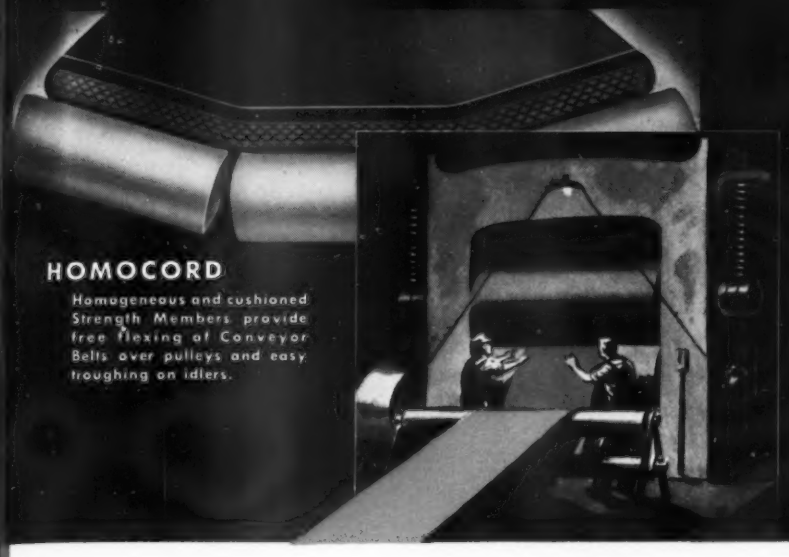

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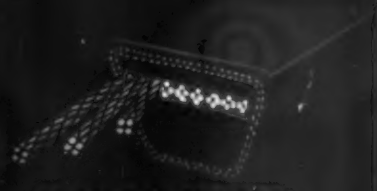

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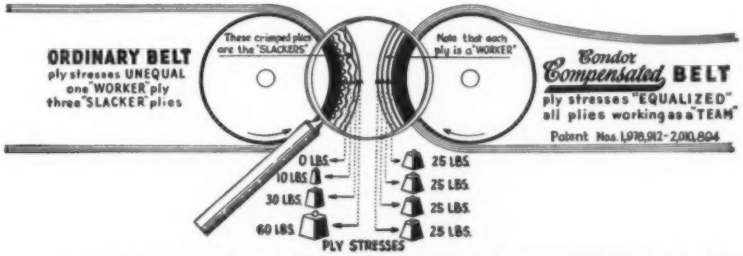

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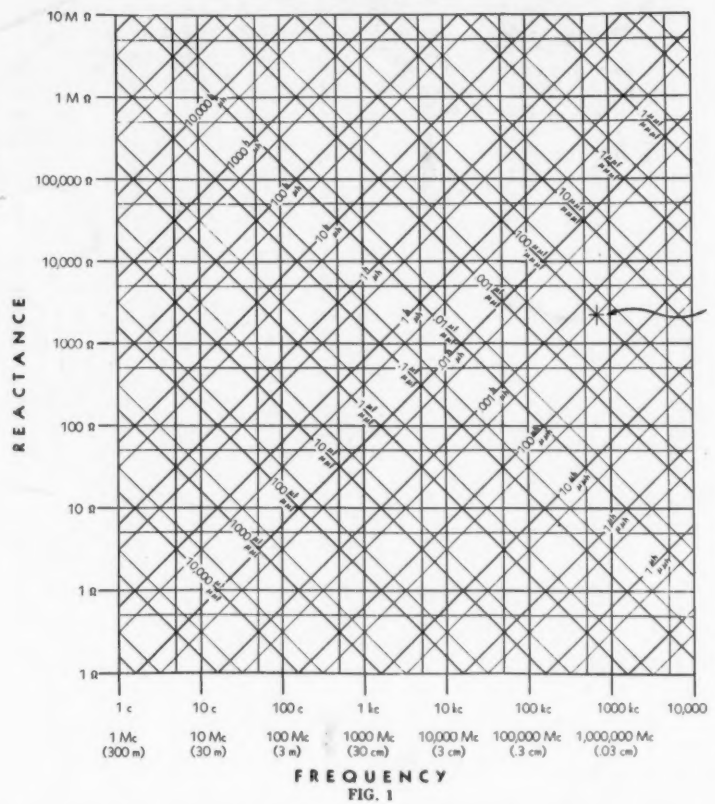


FIG. 1

Always obtain approximate value from Figure 1 before using Figure 2

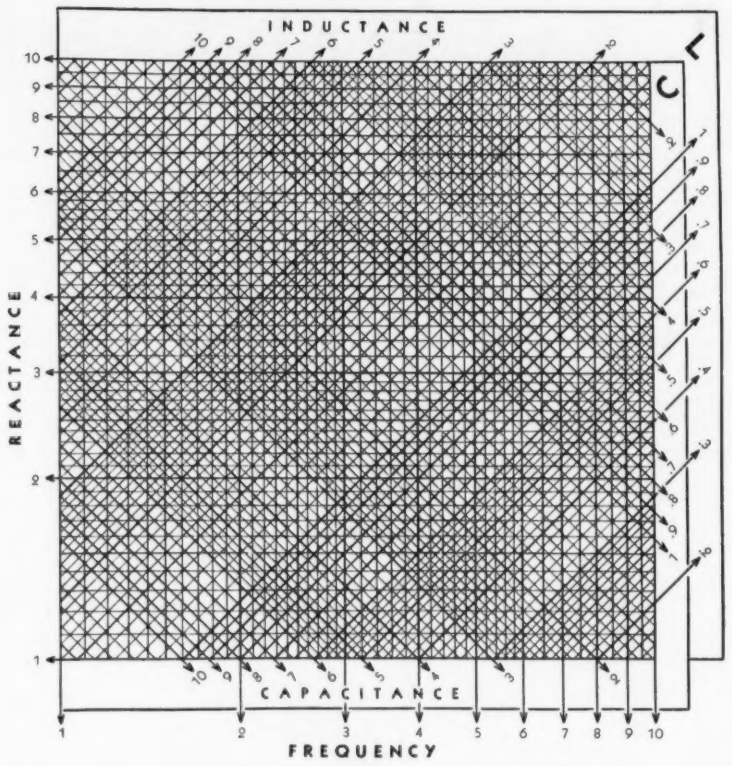


FIG. 2

The accompanying chart may be used to find:

(1) The reactance of a given inductance at a given frequency.

(2) The reactance of a given capacitance at a given frequency.

(3) The resonant frequency of a given inductance and capacitance.

In order to facilitate the determination of magnitude of the quantities involved to two or three significant figures the chart is divided into two parts. Figure 1 is the complete chart to be used for rough calculations. Figure 2, which is a single decade of Figure 1 enlarged approximately 7 times, is to be used where the significant two or three figures are to be determined.

TO FIND REACTANCE

Enter the charts vertically from the bottom (frequency) and along the lines slanting upward to the left (capacitance) or to the right (inductance). Corresponding scales (upper or lower) must be used throughout. Project horizontally to the left from the intersection and read reactance.

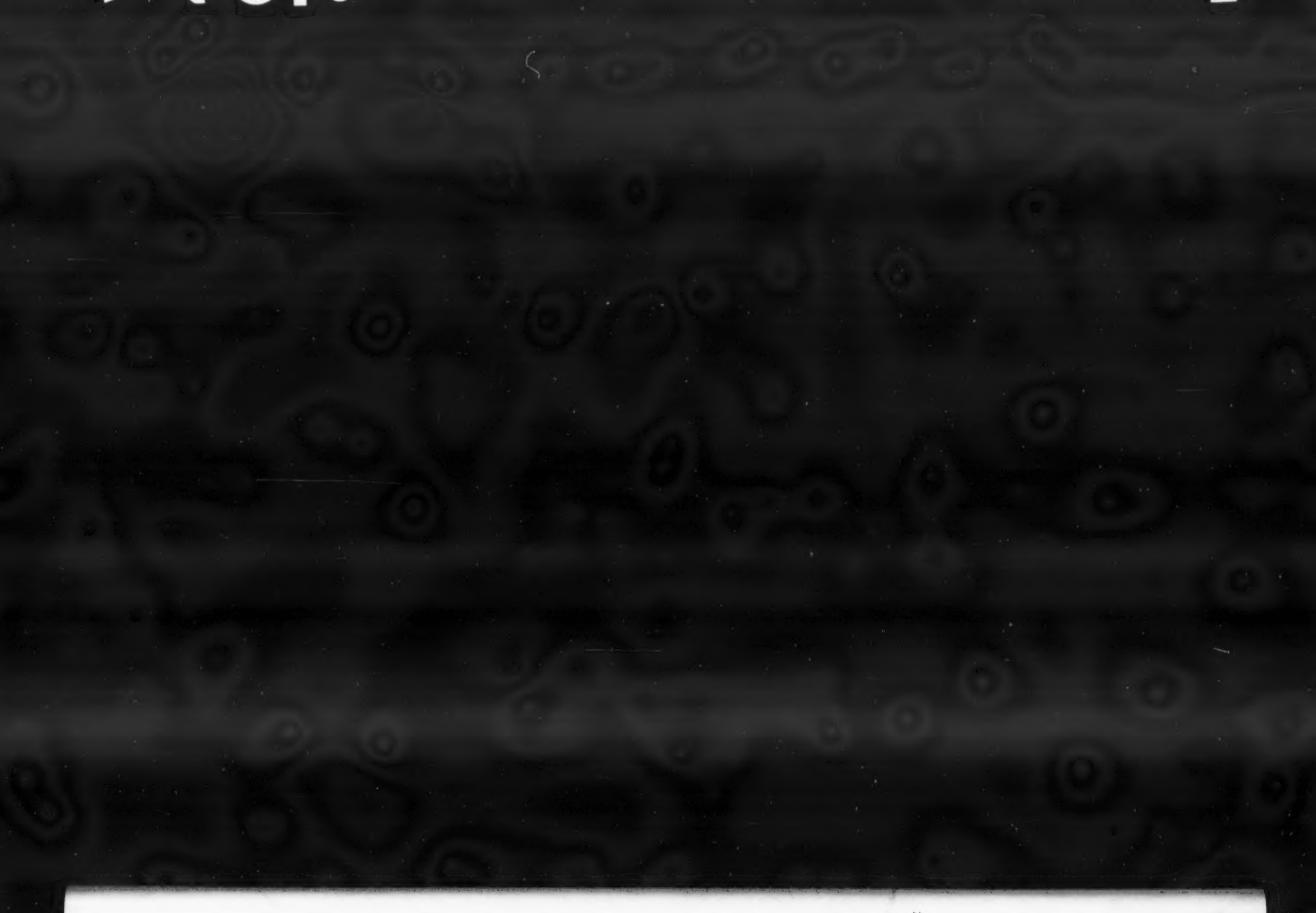
TO FIND RESONANT FREQUENCY

Enter the slanting lines for the given inductance and capacitance. Project downward and read resonant frequency from the bottom scale. Corresponding scales (upper or lower) must be used throughout.

Example: The sample point indicated (Figure 1) corresponds to a frequency of about 700 kc and an inductance of 500 μh, or a capacitance of 100 $\mu\mu$f, giving in either case a reactance of about 2,000 ohms. The resonant frequency of a circuit containing these values of inductance and capacitance is, of course, 700 kc, approximately.

USE OF FIGURE 2

Figure 2 is used to obtain additional precision of reading but does not place the decimal point which must be located from a preliminary entry on Figure 1. Since the chart necessarily requires two logarithmic decades for inductance and capacitance for every single decade of frequency and reactance, unless the correct decade for L and C is chosen, the calculated values of reactance and frequency will be in error by a factor of 3.16.

Example: (Continued) The reactance corresponding to 500 μh or 100 $\mu\mu$f is 2,230 ohms at 712 kc, their resonant frequency.

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